SCIENTIFIC AMERICAN

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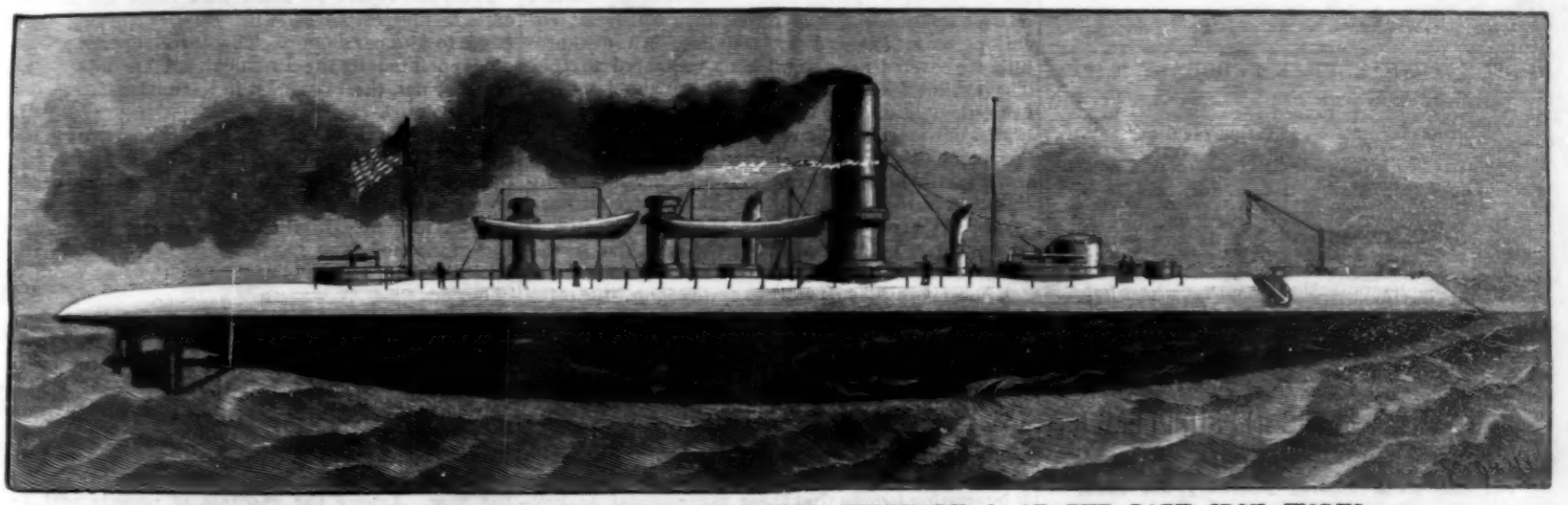
THE HARBOR DEFENSE RAM KATAHDIN.

A vessel which stands alone in its class, the first vessel of our new navy built solely to be used as a ram, and one which is laid out on original lines as compared with work in a similar direction in foreign navies, was launched at the Bath Iron Works, Me., on February 4. Not belonging to any of the classes of vessels for which names are provided by law, it was christened Katahdin, after Mount Katahdin, the highest mountain in Maine. A distinguished company of guests was present at the ceremonies attending the launching, including the Assistant Secretary of the Navy, James R. Soley, Senators Hale and Frye, Thomas A. Edison, and the members of the Maine Legislature in a body. The launch was a success, the vessel sliding gracefully and easily into the water.

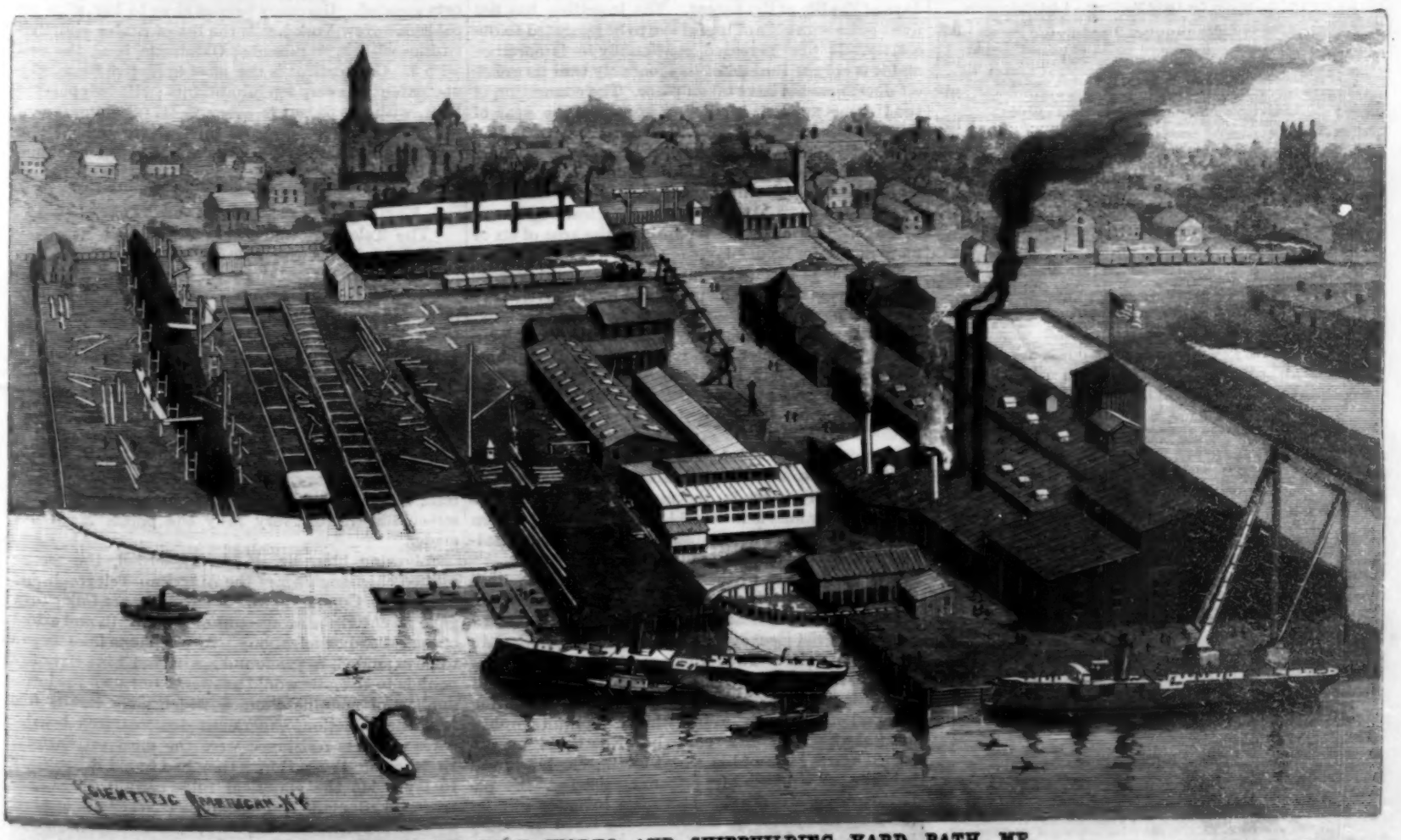
The Katahdin is a twin screw armor-plated vessel, built from the designs of Rear Admiral Daniel Ammen, and is based upon the personal experience of the admiral in the use of and the defense against rams in our civil war, 1861-65. The plans were made in the Bureau of Construction and Repair, under the supervision of Commodore T. D. Wilson, in consultation with Admiral Ammen, and the machinery was designed in the Bureau of Steam Engineering, under the supervision of its chief, Commodore George W. Melville. The bids for her construction were opened at the Navy Department on December 20, 1891. There was one bidder only, the Bath Iron Works, and on January 28, 1891, the contract was awarded to this company to build and equip the vessel and machinery and to place the armor for $930,000, to be completed by July 28, 1892.

On March 27, 1891, the Navy Department approved the proposition of the contractors to lengthen the vessel eight feet, the corresponding increase in the displacement (133 tons) to be utilized in increasing the coal supply and providing a battery of four 6-pounder rapid-firing guns for defense against torpedo attack, the original design having no battery whatever. The type and size of the boilers were also modified. With these changes the dimensions of the vessel are as follows: Length over all, 251 feet; length on the normal water line, 250 feet 2 inches; extreme breadth, 43 feet 5 inches; breadth on water line, 41 feet 6 inches. The total depth from the base to the crown of deck amidships is 22 feet 10 inches, and the normal draught of water is 15 feet, the corresponding displacement being 2,155 tons. The lower portion of the hull is dish shaped up to a sharp knuckle, which runs all around the vessel 6 inches below the normal water line, the angle of the knuckle amidship being about 90 degrees. Above this knuckle the shape of the hull is a circular arc, with a radius amidship of 30 feet, rising from 6 inches below to 6 feet above the normal water line. This curved deck is armor-plated throughout, the thickness of the armor tapering from 6 inches at the knuckle to 2 inches at the crown of the deck. Above this deck is a conning tower of 18-inch plate, a smokepipe and ventilators, and two light barbettes, within which the guns will be mounted, and skid beams for carrying the boats. Longitudinally from the point of the ram to the stern the lower portion of the hull is shaped in a fair curve, but the upper portion is straight from the head of the stem to within about thirty feet from the stern, from which it rounds

(*Continued on page 100.*)



THE HARBOR DEFENSE RAM KATAHDIN, LAUNCHED FEBRUARY 4, AT THE BATH IRON WORKS.



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NEW YORK, SATURDAY, FEBRUARY 18, 1893.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 894.

For the Week Ending February 18, 1893.

Price 10 cents. For sale by all newsdealers

THE CROWNING ACHIEVEMENTS OF THE TELEPHONE.

Two exhibitions of recent achievement in the line of telephony have recently taken place in this city. The first one signalized the opening of the telephone line from New York to Chicago. The next one was a public exhibition of the capacity of that line given by the transmission of music over the thousand miles intervening between here and the City of the Lakes. The music was so perfectly reproduced as to be heard by members of a large audience. To day New York is in telephonic communication with Chicago, and the oral transmission of intelligence has become an everyday affair. When the telephone was first introduced, it was believed that it would never have a very extensive application. It seemed impossible that all the leading business offices in such a city as New York should be put in communication with each other in any practical way by the almost impracticable invention of seventeen years ago. After the development of the telephone with microphonic transmitters for short distance work had become an acknowledged fact, the troubles offered by induction and the static capacity of long lines caused many to believe that the telephone could never be a long range instrument. As in the case of many other things in this world, it was found that the best appliances secured the desired results. The construction of an absolutely first-class copper line of large caliber wire and of the most perfect details of mounting has removed the thousand miles intervening between here and Chicago effectually, and now conversation can be held with Chicago even better than ordinarily with New York City connections. The success of long distance telephoning in the present case is merely one of the additional triumphs of the best.

On February 7 of the present year, a still greater achievement was commemorated. On that day was witnessed the opening of the telephone line from Boston to Chicago. Telephoning is successfully carried on over 1,250 miles of wire, owing to a somewhat circuitous route followed by the line. All distances hitherto covered are insignificant compared to this. The possibilities it holds for the future cannot well be overestimated. A step beyond Chicago and the banks of the Missouri will be reached, and we may yet see Omaha and San Francisco connected by a line which will form the final link in a chain bringing San Francisco and New York within speaking range of each other. When conversation is carried on perfectly as it now is over 1,250 miles of wire, the extension of distance becomes a matter of detail.

A few days after this reaches our readers, the original Bell telephone patent, to which the courts have awarded an unprecedentedly wide scope, will have expired. The expiration of the patent and opening of the field of telephony to the nation is, under the circumstances, a signal epoch in the history of invention. Seventeen years ago the patent was granted. Under energetic business management the industry based on this patent attained an enormous development, and it is interesting to note that these monumental achievements have only been accomplished during the last days of the life of the patent. The invention has not lived out a short life of usefulness to be relegated to obscurity. It has increased continually in importance and it is only at the end of its monopoly that its greatest developments have taken place. The connection of the two metropolises is a fitting work for the year of the Columbian Exposition. The American invention of the telephone will have in these commercial lines erected for everyday use its most impressive exposition—an exhibit which will far surpass anything that can be shown in the great halls of the electrical building of Chicago. It is an exhibit requiring the area of six or more States for its display.

The value of this invention in a money-making sense has been enormous. The price paid by the inventor of the telephone for his protection, technically speaking, becomes payable in a few days. The price paid for a patent is its surrender in statutory time to the public. The patent fee is merely designed to cover the expense of the office, and is no part of the consideration given by the inventor. But if we take an enlightened view of the matter, we will see that during its existence the Bell patent, by the convenience it has afforded the public in the transaction of business, has awarded the public a rich return for the monopoly granted. The convenience alone is invaluable, and the money return to business men in the transaction of important matters cannot be overestimated.

The completion of these great long distance lines marks the beginning of a epoch when telephony will acquire a new importance. Were the patent awarded a further existence, every year would witness for it an increase in value. The returns received for the patent hitherto have been in great part based upon what it did during its struggling years of business, and during a period of great uncertainty when it was quite problematical what its results were to be. Now that it has obtained a firm lease of life, now that the telephone itself is in the full strength of a matured existence, the patent lapses. It is the old story; the inventor obtains the least reward for his exertions; the true beneficiary is the public. Estimating the benefit which the public has received from the invention, had the return been one hundred fold to the owners of the invention, the reward even then for what has altered the whole face of business and commercial life would have been not a particle too much. The spirit of our patent system is admirably illustrated in the whole matter. An invention is made; the incitement for making the invention is the award by government of a short monopoly conditional on its being patented; that is, disclosed to the public. Thus incited, the inventor works to achieve his result, achieves it, and obtains what return he can in the seventeen years of its life. Then, in the full vigor of an assured success, with the most brilliant prospects before it, after having revolutionized the business world, the invention becomes public property and the inventor loses all claim upon it.

The moral in the history of the telephone applies well in the case of the would-be minimizers of patent rights. For just as the invention is in its most advanced state of development and has the most brilliant future before it, when the returns from it should be of unprecedented and of growing largeness, it becomes public property and part of the capital of the American nation at large.

THE ANNUAL REPORT OF THE COMMISSIONER OF PATENTS.

The annual report of Commissioner Simonds, dated January 31, has been issued. It is contained in the Patent Office *Gazette* of February 7. The general report deals with the old questions which unfortunately are very live questions—questions which we have repeatedly dilated on in these columns. Want of room, want of facilities and want of help are the crying needs of the office. The delay in disposing of patent cases is very great, but no relief is granted by Congress.

From the report we learn that there are now 605 officials and employes, with salaries varying from $5,000 to $360 per annum. The three superior officers are appointed by the President, 464 are under civil service rules, the remainder in the unclassified service are appointed.

For the World's Fair an exhibit including some 2,500 models, nearly all working models, is in preparation. It will include many loans from inventors in addition to original models in possession of the office, and will form an exhibition of interest quite unique. One of the models goes as far back as 150 B. C.; another illustrates a harvester used in the first century of our era.

The net receipts of the office were $1,286,331.83. The expenditures were $1,110,739.24. The balance in the United States Treasury to the credit of the office reached on January 1, 1893, the sum of $4,179,910.26. During the year 1892, 39,514 applications for patents for inventions were received, 104 for reissues and 1,130 for design patents; 23,478 patents were issued and 81 reissues were granted; 13,291 patents expired during the year. Among the grantees of patents next to America comes England with 653 United States patents granted. Germany presses close to her with 507 patents. New York heads the list of States and Territories with 3,781 patents; Oklahoma is at the foot with 3. Connecticut is the most inventive State, with one patent to every 955 inhabitants; Mississippi is the least, with one patent to every 23,447 inhabitants.

The report is of unusual interest throughout, and in our brief summary we have left much of it untouched.

PROGRESS OF LONG DISTANCE TELEPHONY.

"The Telephone and How We Talk from New York to Chicago" was the title of an interesting experimental lecture given before the New York Electrical Society, at Columbia College, New York, on the 8th inst. Mr. J. J. Carty, the electrician of the Metropolitan Telegraph and Telephone Company, explained the nature of sound and the mechanism of speech, its propagation and reception by the ear, the physiology of the ear, the evolution from the speaking tube and string telephone to the electric telephone, a description of the construction and principle of the latter, and the construction of the transmitter, induction coil and the battery. By means of an electric arc lantern, diagram lantern slides were projected on the screen, illustrating very fully the points Mr. Carty made.

Following him, Mr. F. A. Pickernell, the accomplished chief engineer of the American Telegraph and Telephone Company (the Long Distance Company), gave an entertaining account of the growth and extent of long distance telephony. As telephone lines began to be extended, it was found a wire weighing sixty-five pounds to the mile would answer. But with the introduction of metallic circuits, which gave results free from the induction, experience demonstrated heavier wires with less resistance were the most satisfactory. In learning these things they had found it necessary to lay aside the empirical rules certain noted electricians had made and establish a standard of their own, as it appeared to be a special science, requiring special conditions. The early experiments were tried

on wires already existing in 1884 between New York and Boston. Later a special line was built between the same cities, which gave fairly good service. The next line was established between New York and Philadelphia, heavier wire being used, which gave results so superior to any previous line that it led the company to enlarge in the same direction. Other lines then followed from New York to Troy, Troy to Buffalo, Philadelphia to Pittsburg, Philadelphia to Washington, and from Pittsburg to Erie, Pa.

By a certain combination of several of these lines, a continuous circuit of 800 miles or more was effected and experimental tests made. The trials gave the engineers an insight as to the practical possibilities of the construction of an efficient line between New York and Chicago, and by further calculations they were able to determine what the size of the wire should be. Hard drawn copper wire, weighing 435 lb. to the mile, was finally adopted, and its use on the line to Chicago has fully verified the calculations. It operated perfectly in all kinds of weather, and would work well with an additional 250 miles added on to either end. A new special line had just been opened between New York and Boston, of the heaviest wire, which enabled conversation to be carried on perfectly between Boston and Chicago. In transmitting sound by electrical pulsations over these great distances, it was somewhat diminished in volume, but was very distinct and perfectly understood. In remarking upon the instantaneous nature of the transmission, he gave two comparative illustrations. Taking the hawk for example, if it could fly at its fastest speed it would take six hours to go from New York to Chicago; or, if a rifle was fired at its highest velocity from New York to a target in Chicago, it would take one hour's time. But in the telephone the element of time was eliminated, the impulse traversed the distance instantaneously, and the reply returned as quickly. Its rapidity is inconceivable.

Lantern illustrations were given of the interior of the New York Long Distance office, also of the Chicago office, and of the terminus at Jersey City, the subway pipes, the different pole lines passing out of the city, plans for putting up poles, the old and new system of fixtures for house top lines, and views in the country showing the lines of poles and cross arms.

Everything about the long distance lines is constructed in a solid, permanent character, provision being made for further enlargement when demanded.

At the end of his interesting talk he invited the audience to listen through the forty telephones in circuit to the music of a cornet and banjo that would be played in Chicago, and to any conversation that might be carried on.

The companies had connected the wires temporarily with the lecture room for this purpose. The experiment was most successful, every note and fluctuation in the notes of the Chicago cornet were heard with a volume and distinctness that was quite remarkable, while the intervals between the notes were absolutely quiet, not the slightest interference of the usual telephone induction sound being observed.

It should be mentioned that the views thrown upon the screen were made by Mr. Edward H. Lyon, the gentleman who officiated at the Chicago end of the line when its inauguration took place last October.

Votes of thanks were passed to the lecturers and the telephone companies, and everybody seemed to be satisfied that long distance telephony was to be the coming method of communication. The officers of the society—Mr. Joseph Wetzler, president, and Mr. George H. Guy, secretary—are to be congratulated in bringing about such an instructive and unusual entertainment, and the enterprise of the telephone companies in aiding them also merits favorable mention.

THE EQUITABLE PRINTING TELEGRAPH.

The defects of the telephonic transmission of intelligence sometimes become unpleasantly obvious. When a conflict ensues as to some message that may have been sent at a previous time, there is no way of verification afforded. There is no record of the case. This want has been seriously felt in many instances. In this respect the telephone is inferior to the old time printing telegraphs.

In the Equitable Printing Telegraph, a new and ingenious invention, the difficulty is overcome. In it is presented a printing instrument worked by a keyboard like a typewriter and printing from rubber type its message upon paper tapes. The connection and operation are the acme of simplicity. As an example a pair of instruments were recently set up and connected and put to work in this office in a few minutes.

The transmitting and receiving instruments are identical in all respects, resembling to a certain extent a pair of typewriters. When a message is sent both print it, so that the sender and receiver both have copies of the message.

The great feature of the machines are their automatic unison. The trouble with printing and index machines has been in securing unison of the two instruments, so that both should print the same letters. In the present system this unison is automatically established. If unison is disturbed, the machines at once stop until by touching a lever they are again started in unison. The entire operation of the machines is so simple that it can be learned in ten minutes. Up to distances of fifty miles the system can be used on direct circuit, for greater distances a relay connection with local battery is employed. A pair of instruments can be connected in a telephone circuit and would form a valuable auxiliary to that service. A speed of forty-five words a minute can be obtained.

In practice, a button or key with the desired letter on it is pressed down. When the click announces the printing of the letter, the key bearing the next letter is pressed down, and so on.

There is no need to call any one at the distant end when a message is to be sent. The message is simply

THE EQUITABLE PRINTING TELEGRAPH.

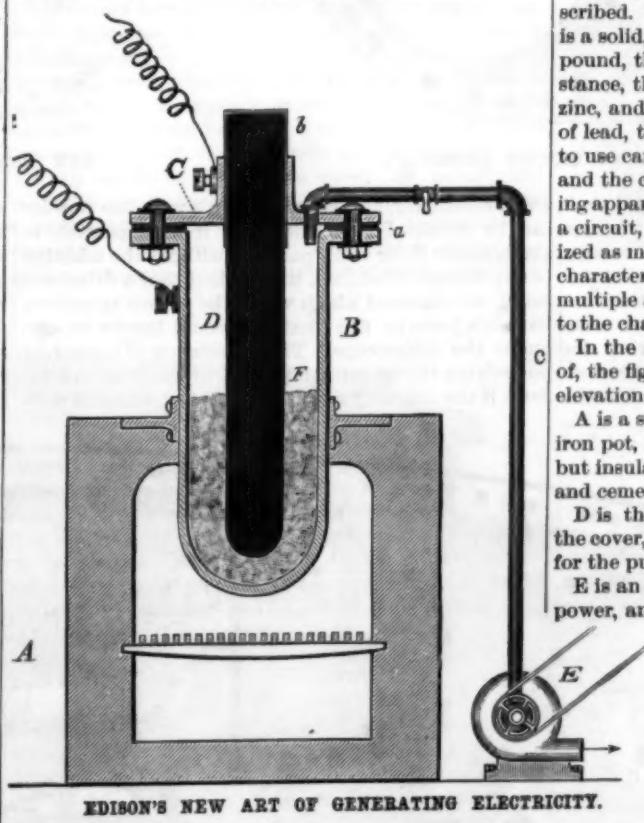
transmitted, and is on the tape when the recipient goes to the instrument.

The system is controlled by the Equitable Manufacturing and Electric Company, 44 Broadway, New York. It presents an admirable simplification of telegraphic service. The expense of these instruments is small.

Edison's New Art of Generating Electricity.

Ten years ago Mr. Thomas A. Edison applied for a patent for this invention, but in some way the Patent Office has managed to withhold the issue of the patent until the present time. The following is an abstract of Mr. Edison's description as contained in the patent issued on the 31st ult.:

The object I have in view is to generate powerful continuous currents of electricity from the elements, and salts or compounds thereof, by dry chemical reaction in a simple and efficient manner. This I accomplish by the use of positive and negative electrodes, placed in a chamber exhausted to the point where the gases generated by the reaction become good conductors of electricity, and subjecting such chamber to the action of heat, to assist the chemical reaction and increase the electrical conductivity of the gases, the positive and negative electrodes being surrounded by a decomposable dry chemical compound, which under the conditions of heat and rarefaction attacks the positive electrode and is decomposed, the reaction generating powerful continuous currents of electricity, which are utilized in a circuit in which the electrodes are located. For the positive electrode may be used any of the metals or metalloids, or carbon, the surrounding decomposable compound being an oxide, chloride, or other salt or compound of an element which will attack the positive electrode under the conditions imposed of heat and rarefaction, while the negative electrode can be any conducting element not attacked by the active compound used. If the result of the action of the compound on the positive electrode is a gas (as would be the case with a carbon electrode attacked by an oxide), the action may be cumulative, or reciprocal as will be presently explained, and a gas being generated, the exhausting apparatus will have to be kept in operation continuously to maintain the desired degree of rarefaction; but, if the result of the action is a solid (as with a metal attacked by an oxide), the action would not be cumulative, and no gas being generated, only sufficient action of the exhausting apparatus would have to be maintained to overcome the leakage, and this might be done by a continuous or intermittent operation of the exhausting apparatus.



EDISON'S NEW ART OF GENERATING ELECTRICITY.

In carrying out my invention, I employ a suitable pot or vessel, for instance one of iron, having a tight cover, and connected with suitable exhausting apparatus for producing the proper degree of rarefaction therein. The iron pot may form the negative electrode of the apparatus. By the cover is supported the positive electrode of carbon, which makes good contact therewith and hangs down into the pot. This carbon electrode may be a cylinder made by compressing powdered bituminous coal and then coking the same slightly, the compression being continued during the coking, or a piece of wood may be carbonized under pressure to produce the electrode. The upper end of the electrode is copper-plated, to make a close fit with the sides of the opening in the cover through which it passes, and to make good electrical contact with such cover, or the cover may be solid and the carbon electrode be hung from the under side of the same.

The vessel is provided with a metallic oxide partly filling the same and surrounding the carbon electrode. Oxide of iron is suitable for the purpose. This vessel is mounted in a suitable furnace for giving the necessary heat to produce rapid chemical reaction. The temperature being raised to the point where the carbon will be attacked by oxygen, carbonic oxide will be formed, which being a powerful reducing agent will reduce the oxide of iron, producing metallic iron and carbonic acid. The carbonic acid will attack the carbon, consuming a portion thereof, forming carbonic oxide and changing the carbonic acid to carbonic oxide. The increased volume of carbonic oxide will act on the oxide of iron, reducing the oxide of iron and forming carbonic acid, which again attacks the carbon, and so on, this cumulative or reciprocal action continuing until the oxide of iron is all reduced or the carbon all consumed. While the cumulative action is taking place, the exhausting apparatus is kept in action, maintaining nearly or quite a definite degree of rarefaction in the vessel, which, with the heat, gives the gases high electrical conductivity, making possible the generation of powerful electrical currents by the cumulative dry chemical reaction described. When the result of the dry chemical reaction is a solid, or a gas which does not decompose the compound, the reaction will not be cumulative. For instance, the positive electrode might be a metal, as zinc, and the compound a metallic oxide, such as oxide of lead, the resulting oxide being a solid, but I prefer to use carbon and an oxide. The body of the vessel and the carbon form the two electrodes of the generating apparatus, and these being properly connected in a circuit, the powerful currents generated can be utilized as may be desired. A number of vessels of this character could be connected with the same circuit, in multiple arc, in series or in multiple series, according to the character of current it is desired to furnish.

In the accompanying drawing, forming a part hereof, the figure represents a vertical section and partial elevation of the apparatus.

A is a suitable furnace, upon which is mounted the iron pot, B, having cover, C, secured tightly thereto, but insulated therefrom by the packing (*a*) of asbestos and cement.

D is the carbon cylinder, passing tightly through the cover, and having its upper end (*b*) copper-plated for the purposes already stated.

E is an exhaust fan driven by any suitable source of power, and connected by a pipe (*c*) with the interior of the vessel, B.

F is the metallic oxide placed within the vessel around the carbon.

1 and 2 are the circuit connections.

Nine claims are made, of which the first is as follows:

1. The improvement in the art of generating electricity, consisting in causing the dry decomposition of a chemical compound, in a rarefied atmosphere and in the presence of a positive element which is attacked by such compound and is electrically charged thereby, and a negative element which is electrically charged by the dry chemical reaction, substantially as set forth.

ROEBLING'S railway bridge at Niagara has a span of 821 feet.

THE HARBOR DEFENSE RAM KATAHDIN.

(*Continued from first page.*)

down to the knuckle. An armor belt, from 6 inches to 3 inches thick and 5 feet deep, extends below the knuckle.

The hull is framed by continuous longitudinal girders, both below and about the knuckle, which, gathering together at the bow and stern, make a rigid structure. A continuous water-tight inner bottom two feet from the outer skin is carried nearly the whole length of the vessel and up to the armor shelf on each side. The vessel is really designed upon the longitudinal bracket system, the frames and beams being intercostal—that is, placed between the ribs. The double bottom is divided and subdivided by longitudinal and transverse frames, so that there are seventy-two water-tight compartments. The inner hull is further subdivided by water-tight bulkheads, both longitudinal and transverse.

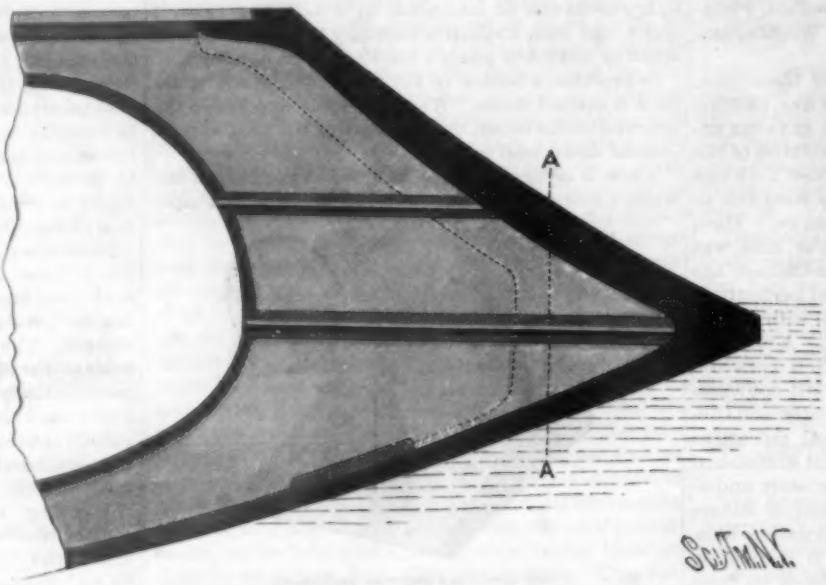
The ramhead is of cast steel (see cut), extending back eleven feet in a vertical line, and it is supported by longitudinal braces in such a way that the force of the blow delivered by it is designed to be distributed through the vessel. The maximum estimated speed, at full power, is seventeen knots, and the impact of the ram is designed to be equivalent to the blow of a hammer weighing over two thousand tons moving at this rate of speed—a blow which, if fairly delivered, would crash through the sides of any vessel afloat.

The motive power consists of two sets of horizontal triple-expansion engines, and there are two double-ended and one single-ended cylindrical horizontal five-tube boilers placed in water-tight compartments. The estimated maximum horse power is 4,800. There will be a complete installation of electric lights, sufficient for lighting all parts of the vessel. It is arranged that the vessel may be submerged to her fighting trim by means of fourteen 8-inch Kingston outboard valves, one in each transverse water-tight compartment of the double bottom, and sluice valves are fitted in the vertical keel and water-tight longitudinals in these compartments. When not so submerged the vessel is designed to have sufficient freeboard for coasting service.

The accommodations for both officers and men will be roomy and as comfortable as can be made on any vessel of similar build. The quarters for the officers will be on the after berth-deck, just abaft the engine-room bulkhead, and the wardroom has seven staterooms and a pantry. The forward berth-deck is designed entirely for the crew, but there is an apartment abaft the officers' quarters which may be used as additional berthing space for a portion of the crew.

The Bath Iron Works and Shipbuilding Yard, where the Katahdin was built, extend over a large area, on the banks of the Kennebec River, twelve miles from its mouth, the depth of water here being ample for vessels of the greatest draught. Several vessels of our new navy have been launched from this yard, two of which are shown at the docks in our first page illustration.

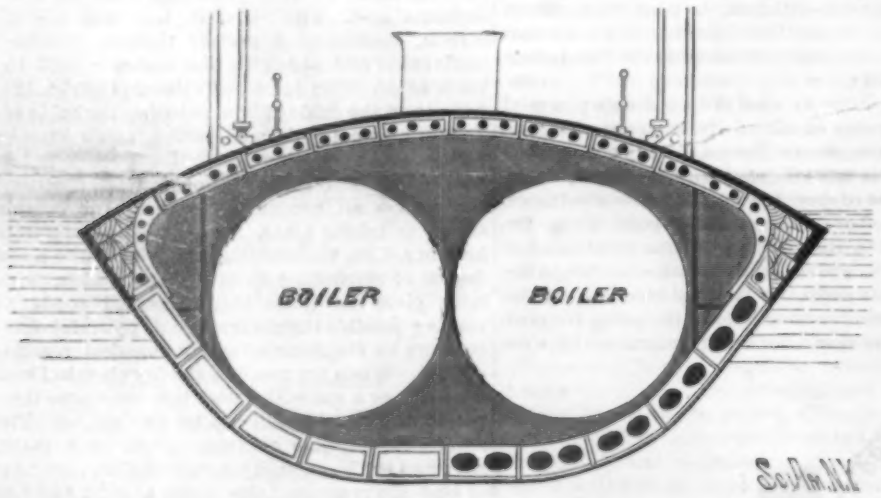
The yard is amply equipped with the most modern appliances in its extensive forge, machine and carpenter shops, and on one of its three launching ways may be seen the Katahdin, as drawn by our artist prior to the launching.



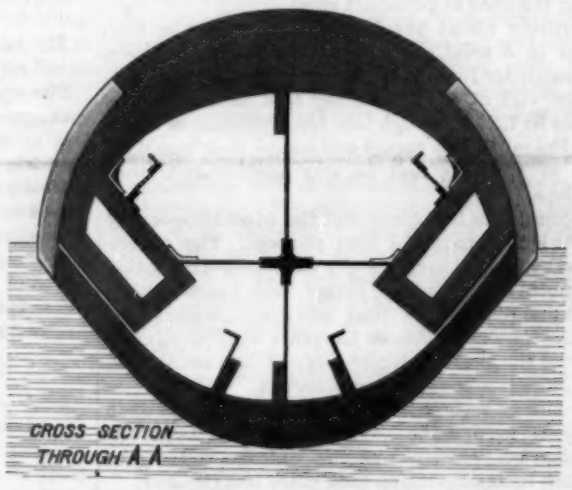
RAM KATAHDIN—LONGITUDINAL SECTION OF STEM.

Asbestos Porcelain.

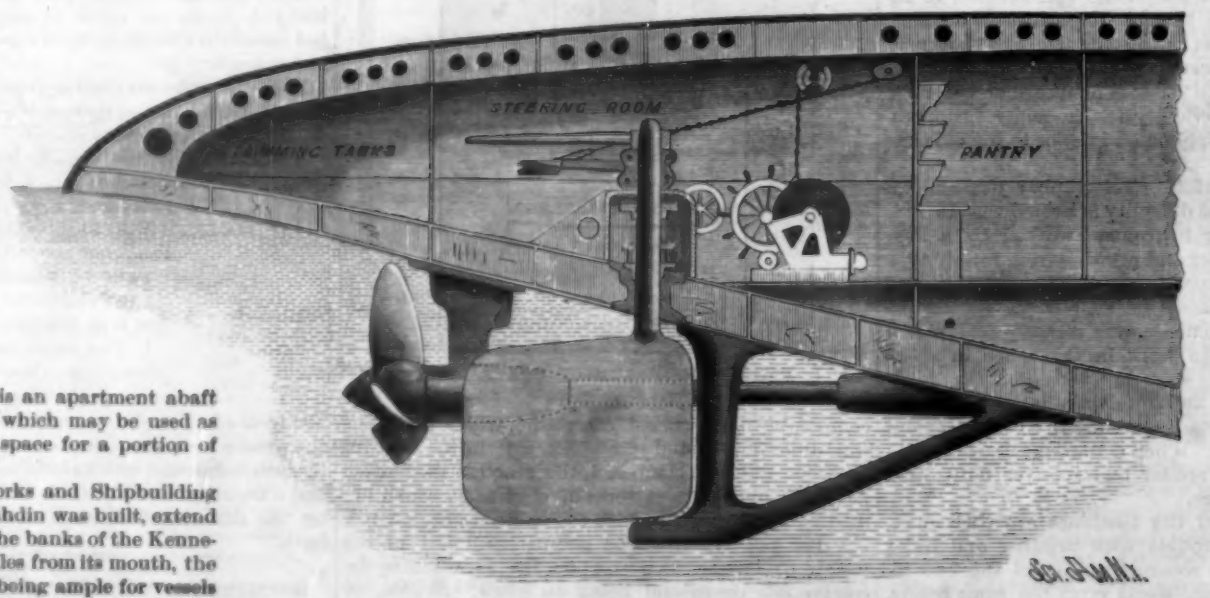
M. Garros is the inventor of a new substance somewhat resembling ordinary porcelain, but which possesses, as he claims, many advantages over that substance. The fibers of asbestos are exceedingly fine, their diameter varying between 0·00016 millimeter and 0·0002 millimeter, and consequently a very fine powder can be obtained from these. If it were possible to amalgamate these small particles without the addition of any foreign substance, it is evident that a substance could be obtained which would be porous in nature, but with pores so fine that they could hardly be seen under the microscope. This substance is formed by pulverizing the asbestos, a process which is rather difficult if the ordinary mortar is used, but which is comparatively easy when the proper apparatus is employed. From this powder a paste is made by mixture with water, and this paste is kneaded, diluted with water, dried and kneaded again, and then moulded into the proper form. By heating the objects in a crucible to a temperature of 1,700° Centigrade, a porcelain is obtained with a translucency comparable to that of ordinary porcelain, and for this reason the inventor has given the name of asbestos porcelain to the substance. If it is heated for 18 hours at a temperature of 1,200° Centigrade, then porous asbestos porcelain is obtained of a light yellow or white color, if care be taken to wash the asbestos powder with sulphuric acid. Professor d'Arsonval states that porous cups made of asbestos porcelain used in electric batteries have much less resistance than the ordinary porous cups, and it has been found that this substance is about 2·75 times a better insulator than the porcelain in common use at this time.—*Electricity.*



RAM KATAHDIN—CROSS SECTION AMIDSHIPS.



RAM KATAHDIN—CROSS SECTION NEAR POINT OF RAM.



RAM KATAHDIN—PROPELLER AND STEERING APPARATUS.

Why Lost People Walk in Circles.

The fact that people lost on a desert or in a forest invariably walk in a circle is due to slight inequality in the length of the legs. Careful measurements of a series of skeletons have shown that only ten per cent had the lower limbs equal in length, thirty-five per cent had the right limb longer than the left, while in fifty-five per cent the left leg was the longer. The result of one limb being longer than the other will naturally be that a person will unconsciously take a longer step with the longer limb, and consequently will trend to the right or to the left, according as the left or right is the longer, unless the tendency to deviation is corrected by the eye.

The left leg being more frequently the longer, as evidenced by measurement of the skeleton, the inclination should take place more frequently to the right than to the left, and this conclusion is quite borne out by observations made on a number of persons when walking blindfolded. Further, on measurement of the arms, it is found that in seventy-two per cent the right arm is longer than the left; while in twenty-four per cent the left arm is the longer, showing that a considerable majority of persons are right handed and left legged. The inequality in the length of the limb is not confined to any particular sex or race, but seems to be universal in all respects.—*Exchange—name unknown.*

WE have received a sample of the latest improved "Landry" pupilometer made by the well known firm of E. Kirstein's Sons Co., of Rochester. This pupilometer gives correct measurement from the center of each eye to the center of the face.

AN IMPROVED DRILLING MACHINE.

The illustration represents a machine more especially designed for drilling coal, rocks, etc., in which a small rotary engine is arranged centrally on the drilling shaft to drive and feed it, the engine being driven by compressed air, steam, or other motive agent. The improvement has been patented by Mr. H. H. Wilderman, of Belleville, Ill. The drill shaft is mounted to slide and turn in a hollow shaft journaled centrally in the engine cylinder, and on this hollow shaft, within the cylinder, is fastened an oval-shaped piston, whose outer ends extend close to the inner surface of the rim of the cylinder. On the rim of the cylinder are trunnions to facilitate supporting the machine in operative position. The piston has internal cavities to contain the lubricant, and apertures through which it may pass outward by centrifugal force to lubricate the cylinder when the machine is running, and the motive agent passes into the cylinder at opposite sides to press on both ends of the piston. The drill shaft is held in

THE WILDERMAN AIR DRILL.

the hollow shaft by keys engaging longitudinal grooves, so that the drill shaft is free to slide while receiving a rotary motion. The shaft has screw threads engaged by half nuts sliding in a casing with a conical head fitting into a two-part sleeve secured by a set screw on a hub on the end of the cylinder, there being a coiled spring at the back end of the conical hub of the casing. By this construction, when the drilling tool strikes a harder substance than the ordinary feed is arranged for the hub of the casing is pushed backward on the spring, retarding the forward movement of the drill shaft while still permitting its rotary motion. This feed mechanism stops all crowding of the machine and prevents choking down in very hard material, or the breaking of the drilling tool and connected parts, the feed of the drill varying automatically according to the hardness of the substance to be drilled.

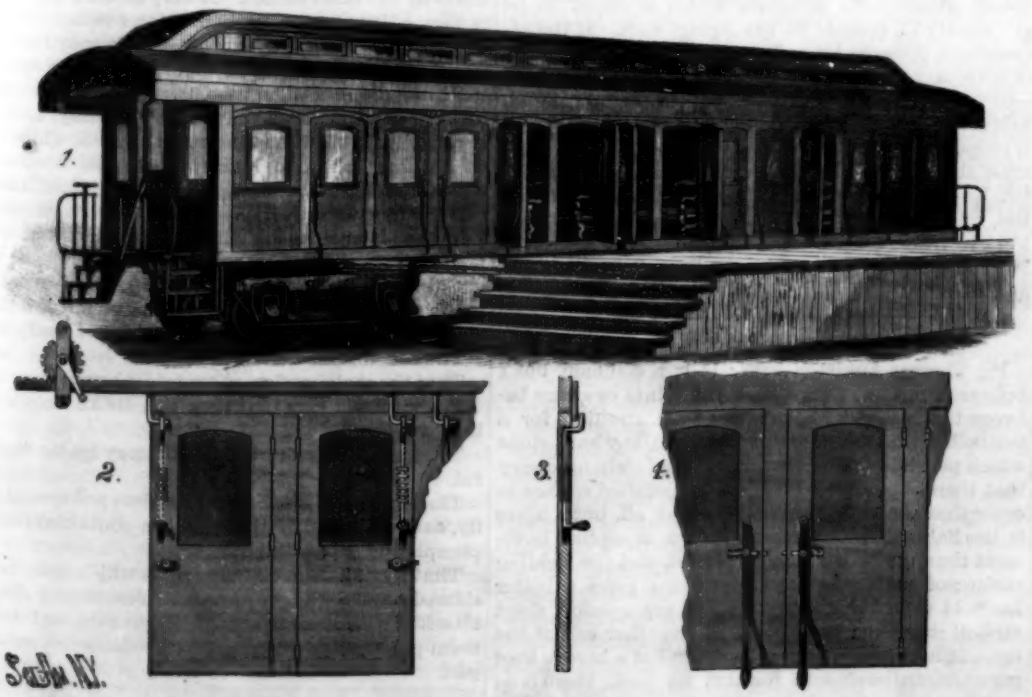
AN IMPROVED RAILWAY COACH.

A passenger car so constructed as to afford ready entrance and exit at its sides is shown in the accompanying illustration. Opposite each seat is a door in the side of the car, and means are provided whereby all of the doors may be simultaneously locked or unlocked, while any one of the doors may be unlocked without disturbing the others. Fig. 1 is a view in perspective of the car, Fig. 2 being a partial side elevation, looking from the inside, Fig. 3 a vertical section through one of the doors, and Fig 4 a partial exterior view.

In connection with this construction it is designed, where deemed desirable, to have steps extend along each side of the car from end to end, such steps being auxiliary to the usual end platform steps, but this feature of the improvement is not represented in the illustration. The doors at the sides are hung in pairs, so that when both doors of a pair are open their outer faces come together, the doors thus not interfering with each other, and each door has a horizontal spring-actuated latch, operated from the inside by an attached knob, or from the exterior by means of a lever which extends downward in position to be grasped by a person at the side of the car, as shown in Figs. 1 and 4. Above the latch is a vertical bolt, sliding in a groove in the door, as shown in Figs. 2 and 3, and to be operated only from the interior of the car, the upper end of the bolt being carried inwardly and upwardly, to form a socket between it and the door, while its lower end is bent outward and provided with a knob. A rack bar, held to slide over the doors on each side of the car, has toothed surfaces near one end engaged by a pinion journaled in suitable brackets and turned by a crank arm, and each of the bars has downwardly projecting L-shaped arms, adapted to engage the upper ends of the vertical bolts, as shown in Fig. 2. The rack bars may be operated independently, or the pinions may be connected to actuate them simultaneously on each side of the car, the movement of the bars in one direction, when the doors are closed, locking all the doors, while by a reverse movement the doors are all unlocked. Each door may be independently opened by drawing down its vertical bolt, which is thus disengaged from the rack arm, the bolt being normally pressed up by a spring.

It will be seen that, with this construction, should a car take fire, or any other accident take place, all the passengers have a convenient exit at hand, and any necessity for crowding through the end doors or forcing a way out of the windows is avoided.

Further particulars relating to this improvement may be obtained of the patentee, Mr. Jesse P. Tillson, Union City, Ind.

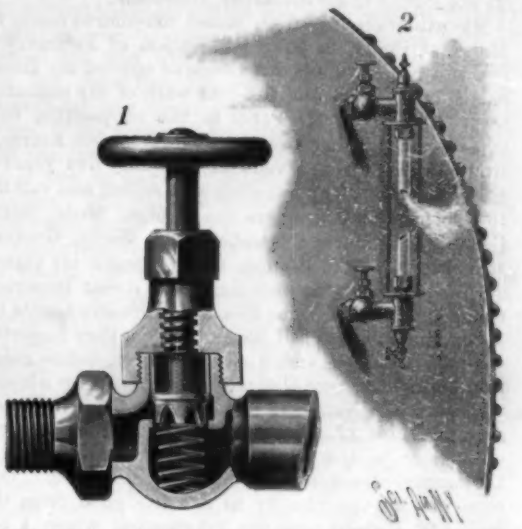


TILLSON'S RAILWAY COACH.

A SAFETY VALVE FOR WATER GAUGES.

The illustration shows a simple form of valve, patented by Mr. John Fishburn, and designed to automatically seat itself in case of accident to the gauge glass, to prevent the escape of steam, water, etc., Fig. 1 representing one of the valves in section and Fig. 2 showing the application of the improvement. Attached to the stand glass are the usual top and bottom T's provided with globe valves, each of the latter having a valve seat on which is adapted to be seated a check valve, held normally off its seat by a spring in the bottom of the valve. A valve stem engages the upper end of the valve to force it to its seat against the tension of the spring. In the check valve for the upper globe valve is arranged a small opening or aperture, indicated in dotted lines in Fig. 1, through which steam can pass from the boiler when the valve is seated, causing an equalizing pressure beneath the check valve, the upper end of this aperture being closed by the lower end of the valve stem. Both valves are normally held off their seats by the springs, permitting steam and water to enter the gauge, but should the glass break, the equalizing pressure is removed, and the valves immediately seat themselves by the force of the steam and water from within the boiler, the escape of steam and water being prevented. When a new glass is to be inserted, the valve stems are screwed down to hold and lock the check valves to their seats.

Further information relative to this improvement

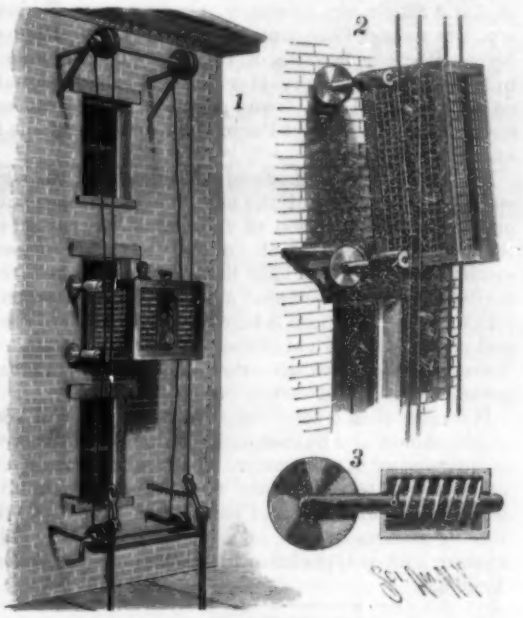


FISHBURN'S SAFETY VALVE FOR WATER GAUGES.

may be obtained of Mr. John A. Cameron, Warden's office, State Penitentiary, Walla Walla, Washington.

AN IMPROVED FIRE ESCAPE.

The device shown in the illustration is of simple and inexpensive construction, designed not to injure the building to which it is attached, and affords special facilities for rescuing women and children. On the ground near the building, beneath a vertical row of windows, is located a windlass having end sheaves on a shaft and an operating crank, and in a line therewith at the top of the building, on a shaft journaled in suitable brackets, are corresponding sheaves, wire hoisting ropes passing over these top and bottom sheaves, to carry the cage, as shown in Fig. 1. The cage is open on the side facing the wall, and is fast-



BRUCE'S FIRE ESCAPE.

ened to the hoisting rope by hooks or staples in such way as to hold the cage close up against the wall. To enable the cage to travel over window caps and cornices, as shown in Fig. 2, clearer wheels are attached to its inner corners, these wheels being journaled in yielding bearings, as shown in Fig. 3, preventing undue friction of the cage against the wall in the up and down movement of the cage. The entire device is of steel or iron, so that it cannot be burned. That the tension of the hoisting rope may at all times be maintained, an idle wheel on a pivoted arm of the windlass is arranged to be drawn against the rope by a spring. The device may be supplied with any desired form of brake mechanism, or the cage may be lowered by slowly turning the crank.

Further information relative to this improvement may be obtained of the patentee, Mr. R. N. Bruce, Sperryville, Va.

THE New York *Sun* explains the reason why most of those engaged in the electric business are young men, in the fact that the development of electricity as a factor in practical life came so suddenly that electricians have not had time to grow old, and many of the responsible men in the telephone and electric lighting business are yet below 40. Every problem presented by the application of electricity to every-day life is now the subject of study by a score of young men trained in a practical school, yet acquainted with the latest discoveries in the theoretical science.

Correspondence.

On the Quality of American Files.

To the Editor of the Scientific American:

My attention has been called to remarks made by Mr. A. D. Pentz, in your publication of February 4, practically putting his experience as against my knowledge obtained within the four walls of my manufactory. To correct Mr. Pentz in the supposition that this knowledge has been obtained from one source, I would say that from seventeen to twenty-five years of age, I was every day handling and selling and talking to dealers and consumers the Grobet, Stubs, Reilly Carr, Jowett, Morse & Gambell, John Martin, Greeves, and other makes of English files. I began my experience with a firm who were large and direct importers of the Grobet and Stubs files, and exclusive agents for John Martin's English files, of which they imported some 500 casks. I ended my experience, before going into the manufacture of files direct, as agent for a house who carried in New York a stock of $40,000 in imported files. I know of no better way of getting a correct opinion as to the quality of goods than to deal with the unprejudiced and prejudiced mechanic. One soon has an opportunity to sift the good from the bad, and I claim that the information which I obtained in handling imported files of various makes for ten years, prior to going into the manufacture of the domestic article, was more accurate knowledge and better information as to various qualities of files than Mr. Pentz was able to obtain in his thirty years' experience as a practical machinist. In justice to myself I would not wish the public to form the impression, through what Mr. Pentz has said, that my knowledge was confined exclusively to my own product.

New York, Feb. 7, 1893. J. D. FOOT.

A Pharmacial Columbus.

The celebration of the year 1893 is not exclusively one devoted to the discovery of America, as far as pharmacy is concerned.

Contemporaneous with this great event, just 400 years ago, a man was born of whom it may justly be said he was the "father of pharmacy." On December 17, 1493, in Maria Einsiedeln, Germany, was born an individual who was named Theophrastus Bombastus von Hohenheim. Possibly because of this high-sounding name, but more probably to avoid criticism of being designated as "bombastic," a term applied to his utterances, he assumed the name of Paracelsus; and as such he is known to pharmacy.

Paracelsus is the founder of iatrochemistry, through which the tendency of the middle ages to speculate upon the transmutation of the metals was turned in the direction of the search for the "elixir ad longam vitum," or the elixir of long life. Paracelsus believed that specifics could be found among plants and animals for all the ills that flesh is heir to. The tincture of aloes and myrrh is a survival of the "elixir proprietatis," or "elixir Paracelsi," which originally contained a much greater number and variety of ingredients.

It is more than a coincidence that the eventful year of 1893 should also be the quadri-centennial of the birth of this pioneer in pharmacy. The great convocation of pharmacy on the continent whose discovery simultaneously with his birth lent such great impetus to the world's materia medica, might well honor this polynymous and polypharmaceutical character.—*Western Druggist.*

Henry Sargent Codman.

Henry Sargent Codman died suddenly, after an operation for appendicitis, on the 13th of January, at Chicago, where he had charge of the landscape department of the Columbian Exposition. No man at his age had ever accomplished more in his profession, or gave brighter promise of what could confidently be expected from his matured powers.

Mr. Codman was born in Brookline, Mass., on the 19th of June, 1864. He graduated at the Institute of Technology in 1884, and almost immediately entered the office of Mr. Frederick Law Olmsted. In the summer of 1887 he traveled with his uncle, Professor C. S. Sargent, through England, France, Germany, and Italy to study living collections of plants, nurseries, parks, and gardens. Soon after, he went to Paris and pursued his professional studies for more than a year under the direction of Edouard Andre, and on his return he was taken into partnership by Mr. Olmsted. Since then he has been intimately associated with Mr. Olmsted in all the important works that have been carried on by that firm, including the design of the Exposition Grounds in Chicago, in the construction of which he has been practically the executive head from the outset. Mr. Codman was tall, strong, of commanding appearance, and apparently of great constitutional vigor. He had inherited a profound love of natural beauty, and his taste had been disciplined and refined by close observation and wide reading. He was thoroughly acquainted with the literature of his profession. His library in this department was unequaled in this country, and his index of works on the subject, published in this journal, was the most complete that has yet appeared.

He invariably gained the confidence and esteem of all with whom he came in contact professionally, and he was remarkably successful in impressing his opinions upon them and leading them to see things from his point of view. That he won the affection as well as the respect of his associates was remarkably manifested in his Chicago work, where he came into warm comradeship with almost the entire corps of artists, and where he helped, no doubt, materially, to bring about that sympathetic co-operation and unity of purpose which has been so marked among them. This was due partly to the fact that from his position he stood for the one uniting element and represented among the various professions and crafts the general design in its comprehensiveness and consistency. But his professional position was made effective by his personal qualities and accomplishments—by that broad, liberal, and catholic cultivation which brought him into cordial and appreciative relationship with all the artists in all their varied fields. His leadership was, therefore, natural and spontaneous, for, although he was modest almost to diffidence, he never shrank from assuming responsibility. He had the moral qualities which mark the master, in addition to the highest intellectual appreciation of the possibilities of his profession, and in view of what he was and of the relations he had established with so many of the foremost architects of the country, his untimely death must be lamented as a serious loss to rural art in America.—*Garden and Forest.*

ATMOSPHERIC PRESSURE.

Completely fill a tumbler with water, and carefully cover it with a small sheet of thick paper, press the paper firmly upon the surface of the fluid with the palm, then cautiously invert the tumbler, and remove the hand. The paper will be held in place, and the water thus prevented from flowing out, by atmospheric pressure, as shown in the cut. The influence of this surface pressure on the boiling points of liquids is plainly illustrated by an experiment shown below, and described as follows: Half fill a Florence flask with water, boil the water until air is displaced and the dome of the flask is filled with steam, cork tightly, quickly remove the Bunsen burner, and invert the flask. When the flame is removed the temperature of the water will not be more than 100° C. (212° Fah.), and by the time the flask is inverted and boiling ceases it will naturally fall below the boiling point. If cold water be now poured carefully over the top of the inverted flask it will cause the water to boil fervently. The cold water, of course, lowers the temperature of the water in the flask still further, but it also condenses some of the steam, and, by thus forming a partial vacuum, lessens the work necessary to boiling. There being enough heat left in the water to accomplish this lessened amount of work, the water boils again until stopped by accumulation of pressure. The flask may be drenched and the water made to boil a dozen times in succession with a single heating, or the experiment can be made more striking by plunging the whole flask under cool water.

At the sea level water boils at 212° Fah., under ordinary atmospheric pressure, which is stated to be 14·7 (nearly 15) pounds to the square inch. If the atmospheric pressure be reduced or removed, by means of a vacuum apparatus, the boiling point is reduced —to 100° Fah. or less. If the pressure be increased, as it is in a steam boiler, the boiling point of the water is proportionately increased—to 350° Fah. or more. It must also be remembered that as we ascend above the sea level the atmospheric pressure grows gradually less, and the boiling point of water is correspondingly lower. Water boils readily on Mount Washington at 200° Fah., and upon Mont Blanc at 185° Fah.—*Bulletin of Pharmacy.*

City Pavements.

Mr. Thomas Appleton says: It is a common, but I believe erroneous, notion that the joints or seams between the blocks of a pavement are essential for a foothold for horses. I grant that with any hard stone which polishes under wear it is absolutely necessary that there should be a limit to the polished surface in order that the horse can stand up at all, but a horse is less liable to fall upon a macadam or asphalt pavement than upon a stone pavement, and the yielding surface of the cedar block pavement gives a better foothold than brick or stone. In my opinion, sheet asphalt should be transferred to the other end of the list. It has such a perfect surface that a horse's hoof comes immediately into position for work, there is no rocking of the fetlock joint, no slipping down into a crevice, no sliding off from a rounded summit. Besides, no such effort is required to start a heavy load as is necessary in starting on a stone or brick pavement. I should rank the materials under this classification as follows: Sheet asphalt, macadam, cedar block, brick, granite, cobble stone.

I doubt the utility of tables giving the cost of pavement for so long a term as fifty years. There may be several better pavements invented than any we now know of within the next ten years. One generation is about as far ahead as we ought to look.

In the present state of the art, I believe that for Chicago and its immediate vicinity there are but two kinds of pavement to use: First, if the abutting property can stand it, sheet asphalt; second, sapless cedar blocks.

On the Danger of Safety Matches.

BY B. L. PROCTOR.

A few weeks ago one of my staff, when lifting down from a high shelf a few packets of patent special safety matches, let two of the packets (each containing a dozen boxes) fall to the floor. This was followed by a sudden burst of smoke from each of them—a result I had not at all anticipated, but which prompted the inquiry how far the matches could be regarded as safety matches, and whether they were really free from phosphorus, as is generally understood.

One thing evidently in favor of safety was that the fire, which destroyed several boxes in each packet, left as many more uninjured. There was fire, but it was all confined within the thin paper wrapper which contained the dozen boxes.

Chemical examination soon proved that the matches did not contain phosphorus, and experiment further proved that the statement was not true which says that the matches will light only on the box.

As this fact was unknown to me up to the present experience, it will probably be new to many others who deal with these articles and who ought to know how far danger may be increased by the supposition that danger does not exist.

It was soon found that by pressing the tip of one match against the tip of another and then suddenly drawing one across the other, one or both of them were ignited. This was, no doubt, the way in which ignition took place within the boxes, where the match tips were, of course, in contact, and where that particular short, sharp friction would be produced by the concussion of the packet upon the floor.

I find Roscoe and Schorlemmer,* under the head of "Phosphorus," give a formula as follows:

Potassium chlorate	32 parts.
Potassium bichromate	12 "
Red lead	32 "
Sulphide of antimony	24 "

This mixture contains no phosphorus, and, as a rule, it will only ignite on a surface strewed with a mixture of amorphous phosphorus and sulphide of antimony. If, however, these so-called safety matches be quickly rubbed over a surface of glass or a smooth sheet of paper, they can be made to take fire.

I do not know whether I had seen Roscoe's statement previous to this little accident, but if so it had not impressed me. Experience is a more emphatic teacher than a text book.

Previous to my reference to Roscoe I had found it possible to ignite the safety matches upon the pages of the day book, upon the office window, upon a long palette knife, upon porcelain jars (glazed or unglazed), and some other materials, a long, rapid stroke being most effective. Subsequently I repeated the experiments and had failures with the same kind of matches made by the same maker. It may be that the matches vary a little in composition unintentionally, or they may change a little with keeping, or it may be that it depends upon the degree of dryness. The matches with which the accident occurred, and which ignited on various surfaces without much difficulty, had been in a warm dry position for a month or so, while those with which failure to ignite with simple friction was experienced had been kept in what might be considered normal conditions—conditions which did not interfere with their lighting on the box, but which made it very difficult, if not impossible, to strike them effectually upon common materials. After two or three hours' drying before the fire, striking on paper and porcelain again became effective, though not easily so.

The conclusions indicated are:

That the matches do not contain phosphorus.

That it is not true that they will strike only on the box.

That when very dry concussion may ignite the boxful.

That in case of ignition the fire does not spread readily, as it would do if the matches contained common phosphorus or free sulphur.

That a small degree of dampness which may be considered normal under ordinary circumstances does not interfere with their use according to rule, and renders them practically free from danger.—*Chemist and Druggist.*

* "Treatise on Chemistry," 1877, vol i., page 474.

The Glacial Period.

RALPH S. TARR.

(*Continued from page* 86.)

There have been two other explanations advanced to account for the glacial period, one geographical, the other astronomical; but I shall not discuss them further than to state them. The first is that the Gulf Stream was in some way prevented from entering the north temperate regions, which were then rendered much cooler. That this might easily happen is admitted; and that if it should happen it would produce a marked effect upon the climate of the North Atlantic basin is certain. The second theory is that, owing to certain rather complicated astronomical changes, the climate of the north was rendered cooler. That these changes occur, all will admit; but whether they are sufficiently marked in their effect to revolutionize the climate is a matter which even the former advocates of the theory do not press with the vigor which they formerly did. Astronomical combined with the geographical causes above mentioned is the theory now advanced most commonly; but for my own part I am inclined to place more stress upon the latter than the former, though, at the same time, it must be admitted that neither theory can be pressed with confidence.

How long did the glacier remain? Here again we can give no definite answer; indeed, we are even more at loss than in the attempt to explain the glacial period. Some believe that the ice covered the land for a great many thousands of years, even hundreds of thousands, and that it was not a single glacial period, but several, between which were periods of warmth, when the ice melted and the land was again clothed with vegetation. American geologists, in most cases, believe there were two periods of glaciation, while some leading European glacialists believe there were four or five such periods. On the other hand, there are some, both in America and Europe, who believe that there was but one glacial period, and that this was a comparatively short one, perhaps not lasting more than thirty or forty thousand years, which, when compared with geological ages, is but a short time.

Another question which may be asked is, When did it disappear? Here again we are not in a condition to state anything definitely, though we are fortunately possessed of some data upon this point which are of value. It is known that before the oncoming of the last glacial epoch the drainage of the great lake region was quite different from the present. There is near the Niagara River a channel, which crosses the river at the Whirlpool, and is the cause of this whirl, which in preglacial times was formed and occupied by a river, the predecessor of the Niagara. It was filled with drift by the glacier, and so, when the ice left the land, the drainage had to form a new channel, being forced out of its own. This it is now doing, having started at Queenstown and cut its gorge back to the present Falls of Niagara. This work is chiefly, if not entirely, postglacial, and if we could obtain a measure of the rate of erosion we could estimate roughly the length of time required for the work, and hence the date when the ice left the land at this point uncovered.

Seeing the importance of this, the New York State Geologist had a map made of the falls nearly fifty years ago, and a few years since a resurvey was made, so that there was a basis for an estimate of the time required for the construction of the gorge. In forty-eight years the American fall retreated 30 feet and the Horseshoe fall 104 feet. The total length of the gorge is about seven miles. There are many variable factors entering into the problem, for there may have been more rainfall formerly, the amount of sediment may have varied, a part of the channel may have been of drift, and other variations may have occurred. Those who have studied the problem carefully and have given the results of their study in figures have placed the amount of time required at from 7,000 to 20,000 years, while Lyell has estimated 35,000 years.

A study of the Falls of St. Anthony, in Minnesota, which have had a similar history, shows that they have retreated about 900 feet since 1680, when they were discovered, and upon this basis the estimate has been made that the close of the glacial period was from 7,000 to 10,000 years ago. There are other evidences which seem to show that the end of the glacial period was not more than 10,000 years ago. This evidence comes chiefly from a study of the deposits left by the glacier, which, in many cases, are surprisingly unchanged by erosion. This could hardly be the case if they had been exposed to the destructive action of atmospheric agencies for a much longer period than 10,000 years. Still, estimates in years must be considered somewhat untrustworthy.

A word or two about the effects of the glacial period is all that can be given in so short an article. It completely altered all details of scenery and of soil. In and on the ice near its end there were quantities of gravel, clay, and bowlders, while beneath it these materials were dragged along as a ground moraine. While the ice was moving, this drift was used by the ice to plane down the hills, to wear out the valleys, and to crush up the loose material into the finest clay. Like a piece of sandpaper, it moved, over the rocks, polishing and grooving them, as any one can see who will examine a freshly exposed ledge in a glaciated region, or the pebbles themselves which occur in the till or unstratified drift. The ice plucked off bowlders and pried off fragments with which to scour the rocks, and there is a school of glacialists which holds that this scouring action of the ice was in places of great force, even causing the formation of deep rock basins, in which lakes now exist.

The more moderate school, however, is of the opinion that the effects of the glacier were constructive rather than destructive, and these effects are certainly more apparent. The soil of the country was completely removed, and in its place was left a bowlder clay, often, as in New England, far too rocky for the agriculturist. The soil is strong because it contains all the elements of the rock, ground to a flour, and never robbed of its plant-forming elements. Before the ice came the soil of New England was very much like that of the Highlands of New Jersey south of the terminal moraine, and one can see the difference in the soil in that State north and south of this line.

The river courses were changed by the sheet of drift which the ice deposited without regard to the contour of the country. Many rivers, such as Niagara, were forced to carve out new channels, and hence the waterfalls and gorges which abound in the glacial region. Others remained in their valleys, but here and there were partly turned aside from their old channels, and in these cases we have small gorges and rapids, where they have settled down through the drift on some rock spur. Where their channels were crossed by drift barriers, lakes were formed, and in the terminal moraine, as the material is called which was deposited at the margin of the melting ice, many lakes are found in the irregularities of the drift deposit. In Minnesota there are fully ten thousand lakes in one way or another the result of the recent glaciation. In New England there are also thousands of lakes and lakelets and swamps which are in many cases nothing but filled up and partly drained lakes or ponds. The Great Lakes are also partly the result of drift barriers.

The streams flowing from the melting glacier were flooded with water and filled with sediment, and terraces were formed, such as those of the Connecticut and of many other streams in the glaciated regions, and even south of it when they received their supply from the glacier. Many other forms were produced by the ice, the kames, drumlins, moraines, and others, all of which add novelty to the scenery of the region where they are found. We owe much to the glacial period, and it is probable that had it not occurred the history of our country might have been quite different, for perhaps even the present climate is a relic of the ice advance. There certainly has been a time when the life of temperate zones extended far within the Arctic circle, and it is not for us to say that there is not some great cycle of climatic change even now in progress, but which in a few hundred years is inappreciable.

The World's Columbian Exposition.

In ground frozen hard the foundations were recently commenced of the large structure to be known as Festival Hall, near the Horticultural Building. Cold chisels and sledge hammers were necessary to start the work. It is promised the new building, which will be one of the notable architectural features of the Fair grounds, will be completed before April 1. It will be used for a choral hall and dedicated solely to music. In style it is pure Doric, which makes it simple and severe in architectural treatment, but massive and striking in appearance. Added to its other charms is the location. Directly fronting the lagoon, across which will be the wooded island with its treasures of landscape gardening and green shore, no more favorable spot could be chosen for a temple to inspiration. F. M. Whitehouse, of Chicago, is the architect. In form the building will resemble an amphitheater surmounted by a dome. On the four sides will project porticoes, the one facing the lagoon being the principal entrance. The porticoes will be enriched with fluted Doric columns six feet and a half in diameter. From the front portico a spacious flight of steps will lead to the entrance, and at the foot of the steps will be two reproductions of celebrated marble statues of the great composers—Handel and Bach. On either side of the main portico will be panels in relief work representing the progress of music, and in the panels over the doors will be relief portraits of Gluck, Berlioz, Wagner, Schumann, Schubert, Mozart, Mendelssohn, Bach, Handel, and Beethoven. The interior is designed after a typical Greek theater, except that the chorus of 2,500 voices will occupy the space assigned by the Greeks to the stage, which will have the effect of rendering the interior amphitheatrical in form. There will be no galleries to obstruct the vision or deteriorate the acoustic properties of the building, which will seat 6,500 people.

In the selection of works of art to be displayed in the Palace of Fine Arts, the juries appointed to decide upon what works should be admitted have pretty generally concluded their labors. In each of the greater cities of this country there have been submitted hundreds of paintings, and from these have been selected the very best. In New York more than 800 canvases were hung for inspection and 375 were accepted. In Boston the examination was even stricter, and 128 out of 600 were accepted. The Philadelphia jury rejected 400, and will send to Chicago 112 paintings. Of the American canvases owned in Europe, the inspection was equally strict. The Paris jury, composed of the very best art critics of the day, accepted 156 canvases out of a total of 840 submitted. And so it was in London, Rome, Berlin, Venice, and Naples. The work of installation in the art palace will begin about March 1.

The extensive exhibit of the great Krupp Company, of Essen, Germany, is beginning to arrive on the grounds. The first consignment of material arrived by the British steamer Gardafee at Baltimore early in January, and special cars were built for its transportation by the Pennsylvania Railroad Company, the gun trucks being from designs furnished by the Krupp Works, and being the largest ever built. The car that will carry the great 124 ton gun, which has not yet arrived, is a flat truck on thirty-two wheels. The carriage of the big gun, which has first arrived, weighs 88,500 pounds, and the frame weighs 55,000 pounds. Among the other first arrivals are the carriage and frame for a 30·5 centimeter gun, whose combined weight is 80,960 pounds, carriage and frame for a 21 centimeter gun, weighing jointly 19,490 pounds, an 85 ton traversing crane, with its equipments, the whole aggregating 56,650 pounds. One 12 centimeter gun, weighing, with carriage and shield, 18,150 pounds, one 8·7 centimeter gun, weighing, with carriage, 7,854 pounds, and one 7·5 centimeter gun, weighing 4,576 pounds. There are also thirty-two railroad tires, weighing 31,224 pounds, two locomotive driving wheels, thirteen pairs of car wheels on axles, and two car wheels without the axles, besides a number of pressed steel articles, empty projectiles, armor and boiler plates, and miscellaneous forgings and steam pumps.

The display to be made by Germany at the exhibition will be very large. The appropriation of the German government for Fair purposes is larger than that of any other foreign country, and the list of German exhibitors now contains 5,077 names. Represented in it are 230 cities and towns of the empire, and of these 40 cities send more than 10 exhibits each. Berlin leads with 288 exhibitors; Munich follows with 187; Leipsic with 149; Frankfort, 55; Hamburg, 57; and Chemnitz, 41.

Nearly $6,000,000 has been appropriated by foreign governments and about $3,000,000 by the several States of this country for appropriate representation at the Fair, as follows:

FOREIGN APPROPRIATIONS.

Argentine	$100,000	Hawaii	$40,000
Austria	102,300	Honduras	20,000
Belgium	57,000	Hayti	25,000
Bolivia	30,000	India	30,000
Brazil	600,000	Japan	630,000
British Guiana	25,000	Jamaica	24,333
British Honduras	7,500	Leeward Islands	6,000
Barbadoes	5,840	Liberia	7,000
Colombia	100,000	Mexico	50,000
Costa Rica	150,000	Morocco	150,000
Canada	100,000	Netherlands	120,000
Cape Colony	50,000	Nicaragua	31,000
Ceylon	65,600	Norway	56,280
Cuba	25,000	New South Wales	249,325
Denmark	67,000	Orange Free state	7,500
Danish West India	1,200	Paraguay	100,000
Dutch Guiana	10,000	Peru	140,000
Dutch West India	5,000	Russia	46,320
Ecuador	125,000	Salvador	12,500
France	733,400	San Domingo	25,000
Germany	800,000	Spain	214,000
Great Britain	291,000	Sweden	106,000
Greece	60,000	Trinidad	15,000

STATE APPROPRIATIONS.

Arizona	$30,000	Nebraska	$50,000
California	300,000	New Hampshire	25,000
Colorado	100,000	New York	300,000
Delaware	10,000	New Jersey	20,000
Idaho	20,000	New Mexico	25,000
Illinois	800,000	North Carolina	25,000
Indiana	75,000	Ohio	100,000
Iowa	125,000	Pennsylvania	300,000
Kentucky	50,000	Rhode Island	25,000
Maine	40,000	Vermont	15,000
Massachusetts	75,000	Washington	100,000
Michigan	100,000	West Virginia	40,000
Minnesota	50,000	Wisconsin	65,000
Missouri	150,000	Wyoming	30,000
Montana	50,000		

It is proposed in Paris to construct a gigantic reflecting telescope, the mirror of which is to be 10 feet in diameter and the length of the tube 140 feet. It is to be ready for the exhibition which is to be held in Paris in 1900. The mirror is to be silver on glass.

M. Trepied, director of the Observatory of Algiers, discusses the magnifying power of such an instrument. The French papers, in announcing the project, made the statement that this instrument would bring the moon within one meter. M. Trepied shows that with the highest practical power, in the best atmosphere, the moon would be seen as if it were 25,000 meters or 15 miles distant.

Steel Axles.

One of the most specious arguments used against steel, the *Railroad Gazette* says, is deduced from the mileage of broken axles, which often show that the average mileage of the broken steel axles is less than that of the iron. This is by no means a conclusive argument; for if the statistics of the axles still running be examined, it will almost invariably be found that steel has proved more durable than iron. The explanation of this seeming anomaly is simple. A new steel axle which has a flaw or is "nicked" in any way is doomed from the start. The crack will gradually but surely spread in the homogeneous material, and the axle will fail or be condemned for a growing flaw after a comparatively short life. The remaining axles, being sound, will continue to run and give a long mileage, and when finally removed will still be sound, though worn below the minimum size. The iron axles, on the other hand, begin the progress of disintegration at once. The more or less imperfectly welded fibers begin to separate, and after a certain time the great majority have been condemned, while the greater number of the steel axles are still running, though possibly none of the iron axles failed as soon as the faulty steel ones.

Steel, however good and suitable in quality, cannot stand unless it is also of suitable form. Some have very incorrectly stated that the section of steel exposed to heavy service should be alike throughout. A car axle, according to this dictum, should be of the same diameter throughout its length. This form, however, was abandoned in the very early days of railroads, owing to the persistency with which fractures occurred just inside the wheel hubs. The true law is manifestly that the section should vary according to the strain, and that the strains should be as nearly uniform as possible throughout the axle, subject to the proviso that there should be no sudden change of form. It will be found that steel fails where this rule is disregarded and stands where it is observed.

One instructive instance is found in the well known case of the bolts by which armor plates are attached to a ship's side. The hard wood backing used between the armor plate and the skin of the hull compresses when the armor is struck by a shot, and its rebound fractured all the bolts tried until Palliser brought out a bolt in which the shank was reduced until its cross section was somewhat smaller than that at the bottom of the threads. When the rebound took place, this bolt stretched a percentage of the whole length of the shank, while with an ordinary bolt the stretch could only take place at the bottom of the threads, and this distance was too short in which to cushion the blow. A large number of failures of steel would never occur if attention were paid to the principle here involved and concentration of the maximum strain carefully avoided.

An Earthquake in Greece.

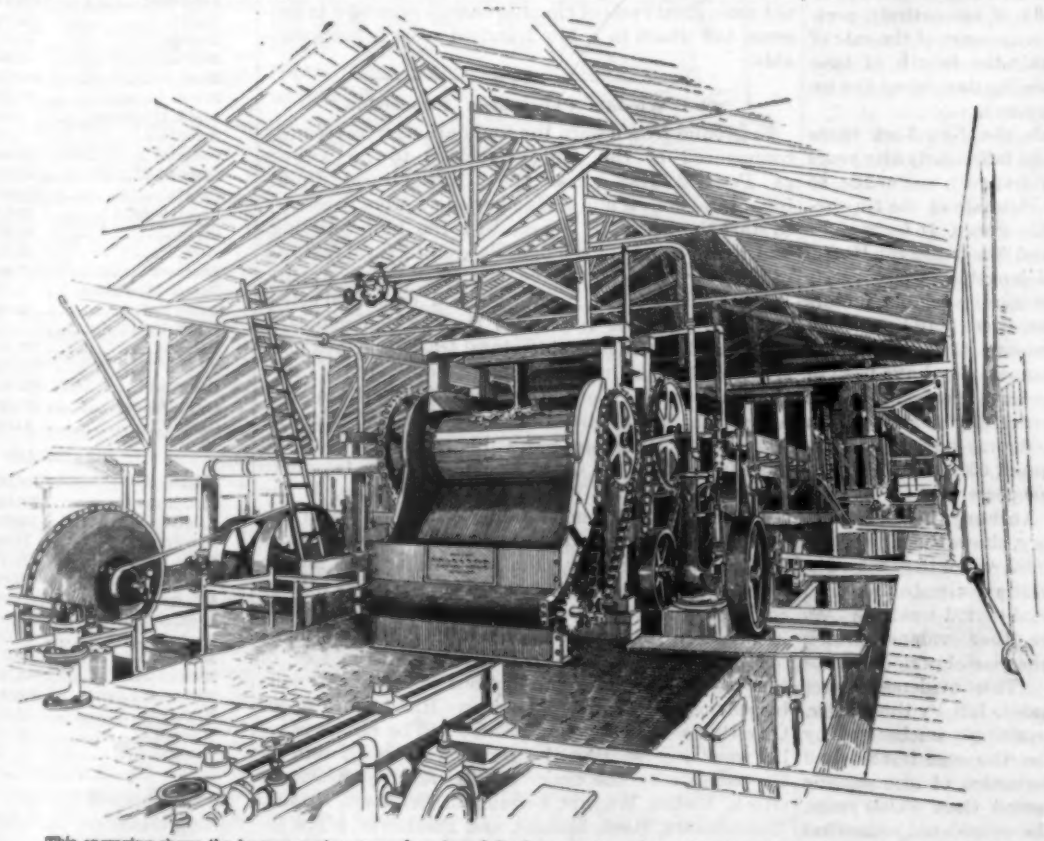
Early in the morning of January 31, the island of Zante, on the west coast of Greece, was severely shaken by an earthquake, during which many business houses were wrecked and the roof of a prison fell in, wounding many prisoners. Two hours later the city of Zante was shaken by repeated shocks, houses fell in all quarters, and the prison became so unsafe that many prisoners were removed. The people, in a panic, fled from the houses and crowded the streets and market place. Scores of families left the town to camp in the fields on the outskirts, and many dead bodies were taken from the ruins, the government sending out troops with tents and provisions for the homeless. On February 2 and 3 other severe shocks occurred, which are said to have wrecked more than a hundred houses in the city of Zante, and proved very disastrous to several villages on the island. Thousands are said to have left the city to sleep in the fields.

A SUGAR HOUSE IN CUBA—LA SOLEDAD.

The island of Zante is 25 miles long and about 12 miles wide, having an area of 277 square miles and a population of about 48,000. The eastern part of the island is a fruitful plain skirted on the west by a range of limestone hills 1,000 to 1,200 feet high. The town of Zante, and its capital, has a population of 16,000.

Labor Troubles in England.

It is astounding nowadays what a small matter will result in a big strike. The men engaged in taking the slag from the furnaces at Barrow by means of two locomotives demanded a third, and on Sunday morning four men thus employed struck work because the duet had not been made into a trio. They were followed by the furnace men, and those employed at the steel works had to follow suit. Thus three thousand men have been thrown out of employment all on account of a donkey engine. The difficulty was all pieced up with the exception of the locomotive men, who, having left their work without notice, were not again taken on. The men demanded this, and the general manager promised to deal leniently with them, but refused to take them back into the employ forthwith. Hence the continuance of the strike on so frivolous a pretext. And this at a time when trade is exceptionally bad, when orders are scarce and profits practically *nil*, and when trade prospects are as gloomy as they well can be!—*Ironmonger.*



This engraving shows the bagasse carrier arranged on top of the furnaces, through openings in which the bagasse is delivered, and passes to the fires.

A SUGAR MILL, CUBA—THE BAGASSE CARRIER.

NOTES ON THE SUGAR INDUSTRY IN CUBA.

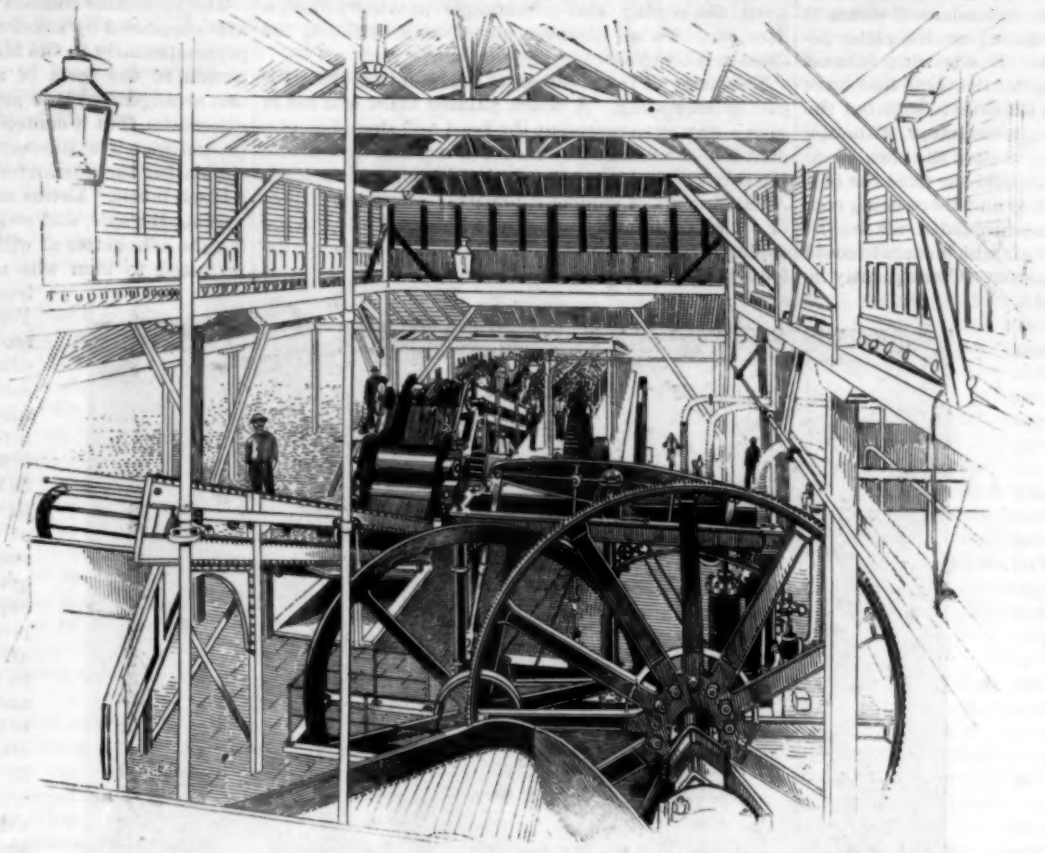
BY HUMPHREY J. KIELY.

It is interesting and gratifying to note the rapidly increasing volume of business between the United States and Cuba. The wonderful natural resources of this fertile island, appropriately called "The Pearl of the Antilles," offer many opportunities for the profitable investment of capital and for the consequent introduction of machinery and various mechanical appliances useful and in many cases necessary in the preparation of the products of its fruitful soil. The island is about 600 miles long, 21 miles wide in the narrowest part and 111 in the widest, and is distant 130 miles from Florida. It abounds in forest woods and produces all the fruits of the tropics in great abundance. It is only within recent years that our trade has increased with this country, and the late reciprocal arrangement has done much to extend that trade, especially when it is remembered that the agricultural commodities produced there are as essential to us as our manufactured products are to Cuba. The mineral wealth of the country, consisting of gold, copper, iron, manganese, asphalt and marble, is immense, but the staple product of the island is sugar, and more capital is invested in the cultivation and manufacture of this one article than in all the others combined. The production this year is estimated at 1,000,000 tons, as against 800,000 tons last year, and the limit of producing capacity has not yet been reached, as large tracts of land are still available for cultivation, and the world's demand is constantly increasing. It is the largest sugar-producing country in the world, the climate and soil possessing just the qualities required for the cultivation of sugar cane, and it is not unusual for a visitor to have pointed out a field from which yearly crops have been taken for a score of years without the aid of fertilizer of any kind. Before the emancipation of the slaves, about twenty years ago, when the plantations were numerous and the price of sugar high, the margin of profit was so great that little attention was paid to economy in production or the use of labor-saving machinery. Many of the small plantations with their primitive methods have been abandoned, and it is not an unusual sight travel ng through the country to come upon the ruins of a once prosperous estate looking desolate and gloomy with its crumbling walls and tottering chimney, and to see flowers and shrubbery flourishing amid the wreckage of its dismantled machinery. This has been due in a great measure to the competition of beet sugar, and now large central factories, fewer in number but far greater in capacity, have taken the place of the numerous small estates.

It is difficult to conceive, without a personal inspection, the immense size and magnificence of the equipment of these central factories, but some idea may be gained from the fact that they each represent an investment ranging from $200,000 to $1,800,000, and comprise in some cases 10,000 acres each. Central Caracas, probably the finest estate on the island, is valued at $1,800,000.

The central factories are usually an assemblage of very large roomy frame structures, in which work goes on night and day without intermission during the entire grinding season, which commences late in December and ends in May. In some factories work is suspended a few hours Sunday morning for the purpose of oiling and cleaning the apparatus, but this practice is not general. The cane is plentiful and each vies with the other in striv-

ing to produce the greatest number of tons, a ready market being found for their entire production. Every hour's delay, therefore, means its equivalent financial loss to the planter, and a serious accident to the machinery, entailing suspension of work, brings with it disastrous results. To guard against this every precaution is taken, and duplicate parts are kept constantly on hand, and the resources for making quick repairs include on the principal estates a fairly well equipped machine and blacksmith shop, and in one case at least—"Central Constancia"—a foundry also. The large estates are also traversed by their own railroads, and locomotives and cars for transporting the cane form part of their equipment. These factories are filled with the most costly machinery of the best workmanship and material, and the whole process of manufacture is, by means of mechanical appliances, almost automatic in its character, as evidenced by the comparatively few laborers found employed. The field hands are, however, numerous, and include males and females of all ages. They are employed cutting cane in the fields, which is transported on railroad cars and heavy carts drawn by powerful oxen to the factory, and there deposited on the slowly moving cane conductor. This is the initial step in the manufacture, and the manual labor practically ends here, as from this time until the sugar is bagged the process is almost entirely mechanical. The cane conductor is one of the most important parts of the equipment, as the stoppage of this cuts off the supply of cane and necessitates the shutting down of the entire plant. The conductor is, therefore, of the best construction, and is usually 125 feet long by 6 feet wide, and extends outside of the main building to allow the cars and carts to run alongside and discharge their contents upon its surface. The cane is piled on haphazard and usually lies in a mass about 2 feet deep on the carrier, as it approaches the crushing rolls at a speed of 15 feet per minute.



The endless belt cane carriers are seen in the distance. The cane is brought from the fields in carts alongside the carrier belts and thrown upon them, and by the carrier belts the cane is delivered to the crushing rolls.

A SUGAR MILL, CUBA—EL SAN FRANCISCO.

The mills through which the cane passes are composed of three heavy chilled steel rolls 38 inches diameter by 7 feet 6 inches long, each weighing 12 tons, and connected by massive gearing. The power required for their operation averages 180 horse power. Notwithstanding their immense size, these rolls spring when grinding, as the great mass of cane is forced through a very small space, the receiving inlet being 1½ inches and the outlet ¼ inch. Their average cost, including the engine, is $30,000.

The cane emerges from the rolls crushed and shredded, the extracted juice running by its own gravity in canals to the defecators, from which it passes through the various stages of manufacture until finally discharged from the centrifugals in dark brown crystals ready for bagging.

In nearly all centrals two mills and in some cases three are used, in order to get the greatest possible extraction of juice from the cane.

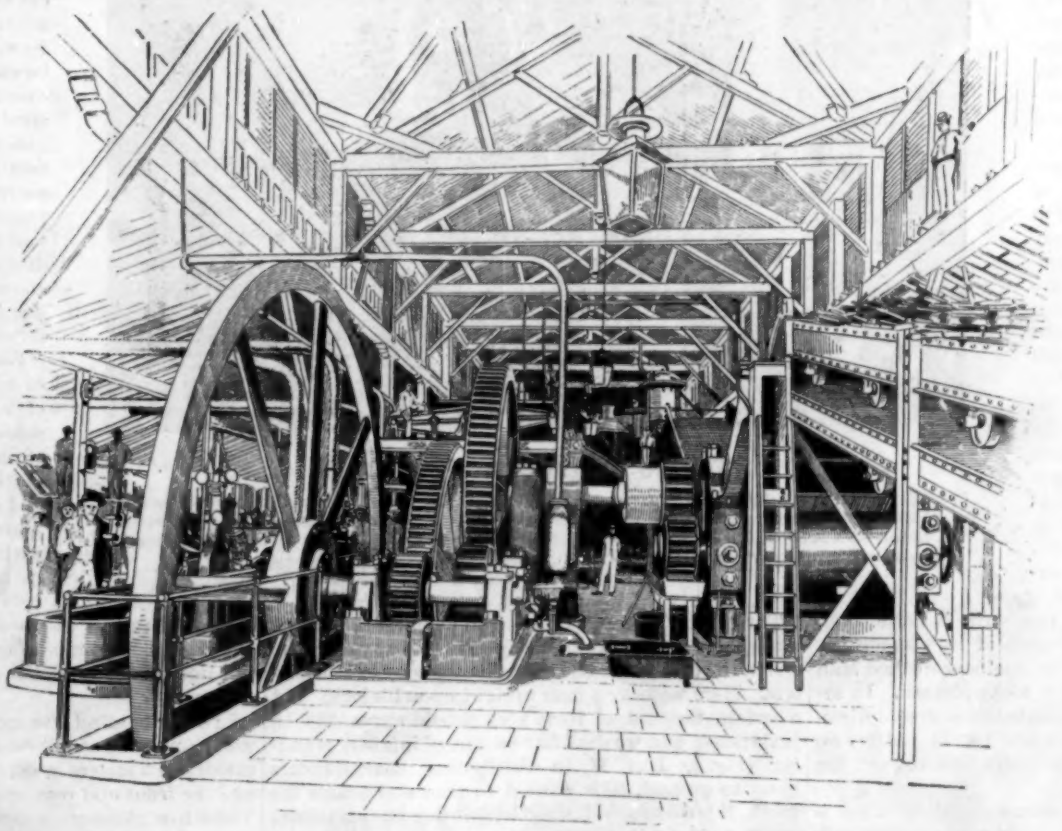
The crushed cane, after passing through the last mill, is called bagasse, and was formerly taken by hand and spread to dry in the sun, and when thoroughly dried carried back and used as fuel. The system now employed, however, is more in keeping with the general marked improvement made in recent years in sugar machinery.

By the present method the green bagasse is discharged direct from the mill on to a bagasse carrier, which consists of two endless link belts running parallel in a wooden trough, with hard maple flights attached at suitable intervals. In this conveyer the bagasse is transported usually a distance of two or three hundred feet to the bagasse burners, and is there automatically discharged into the furnaces especially constructed with forced draught for burning this material.

From this brief description it will be seen that the cane, just as it is cut from the fields, contains within itself not only the raw product, but also the fuel from which the motive power to convert it into the finished article is derived. This is a most important consideration when it is remembered that the cost of coal averages $14 per ton delivered. The owner of one estate paid $12,000 for coal in 1889, and in the following year saved that amount by the introduction of bagasse burners and carriers. This system is now in use in nearly all of the estates.

It will readily be seen what an important market is here afforded for improved machinery and labor-saving appliances, and also how valuable and essential they are to the planter, as without their aid it is practically impossible to produce the product with sufficient economy to compete with others possessing these advantages. The United States is certainly in a most favorable position to develop and by energetic canvass greatly increase this trade, as the present reciprocity treaty admits machinery of American manufacture free of duty, and imposes a heavy tax on the same machinery of foreign manufacture. Coupled with this great advantage is the fact that frequent steamers from New York arrive there within four days, while the comparatively few freight steamers from Europe are usually 16 days in transit.

The average selling price of a bag of sugar is $10, and the estimated cost of manufacturing same $6. It has been stated by those in a position to know that the average net profit to the manufacturer is $1.50 per bag, and as few of the estates turn out less than 50,000 bags per season, it will be seen that the necessary large investment is warranted by the handsome returns.



The crushing rolls are seen at the right, also the cane carriers, which deliver the cane to the rolls.

A SUGAR MILL, CUBA—EL SAN FRANCISCO.

Illuminating Parades from Trolley Wires.

In Wilmington, N. C., the Street Railway Company, of which John H. Barnard is general manager, exhibited during a recent trades parade an extremely simple solution of the problem of satisfactorily illuminating floats for night parades. For the interesting occasion, the Wilmington Street Railway Company offered to take contracts for lighting the floats with incandescent lamps. By several this offer was accepted, and so gratifying were the results that it is most probable that hereafter this method will be exclusively employed. To obtain contact with the trolley wire a very simple trolley was devised. A piece of stiff spring brass wire was coiled in two planes, the lowest coil being fastened to the float. The horizontal coils afforded ample side motion, while the vertical ones gave good upward pressure against the trolley wire. From this various circuits were led about the float, the lamps being connected up five in series. The ground connection was very easily obtained by a little car with iron wheels six inches in diameter, built to fit the gauge of the track, which was towed under the wagon on which the float was built.

Thirty 16 c. p. lamps were found to give a splendid illumination to a very large float, and this, with the simplicity and small cost of the arrangement, makes it quite certain that practically all floats shall be so lighted in the annual parade next year. As their own exhibit the Wilmington Street Railway Company arranged a float on which was seated Benjamin Franklin drawing electricity from the clouds. His kite string consisted of a light bamboo pole, on the end of which was a broad sheet copper contact shoe. This shoe was entirely hidden by the kite, while the bamboo pole was concealed by a dark colored covering, from which fourteen incandescent lamps protruded. The fifteenth was dropped and illuminated the Leyden jar. This float being built on a flat car, the ground contact was obtained through its wheels.—*Street Railway Review.*

How to Keep the Make Shop Free from Steam.

Quentin McGall, of the firm of McGall Brothers, of Orange Valley, has just devised one of the most useful inventions for the hatting trade that can be imagined, and he not only has devised it but he has demonstrated that it will work by practical tests. Every hatter is aware of the difficulty experienced in keeping the sizing department free from fog or condensed steam in the winter months, and many have been the plans devised for obviating the trouble. Hoods with exhaust fans have been placed over the kettles and fans have been placed in ceilings and on the sides to suck out the moisture, but none have been satisfactory, although the hoods over the kettles have worked the best. Since the trouble was caused by the cold air from the outside finding its way into the shop and there being condensed by striking warm moisture-laden air inside, Mr. McGall decided that if the air which came in could be heated it would help the matter. Consequently he had a large steam coil made, four feet square, and placed at one end of the new sizing shop recently put up by the firm. This he incased in a pine box, open at both ends. On the outer end he placed a large steam fan, speeded up to a high point.

When the apparatus was ready for the test the day was one of the coldest of the present season, and a good one to test the plan. The room was full of fog at the time. The effect when the fan was started was almost magical. The steam began to disappear at once, and in a few moments the room was as clear as the outside air and remained so as long as the fan was kept going. When the fan was stopped the steam at once began to accumulate, and in a few minutes the room was as bad as ever. The firm is now arranging to place the device in all their make shops, and other manufacturers have arranged to do the same. The advantages of being able to keep the making departments free from steam are many. The conditions are much healthier, and a better grade of work can be turned out.—*American Hatter.*

THE FONTAINEBLEAU PROVING GROUNDS.

The time when proving grounds were of limited size, and their organization included only a butt and a few epaulements, is already very remote. New conditions have been imposed by the fact of progresses of all kinds realized by artillery. The proving grounds of the present day must necessarily be of great extent and be equipped in such a way that it shall be easily possible to solve most of the problems that are submitted to the art of war. In order to set forth more clearly the economy of such theaters of instruction, it is well to take one example, and we shall, to this effect, select the Fontainebleau proving grounds.

These grounds, directed east and west, occupy in the forest (very near the city) a strip of cleared land, 5·6 kilometers in length by 200 meters in width. Aside from a few hillocks, exercising upon their environs a command of 5 or 6 meters, this strip is quite level. It rises solely by 50 meters at each of its extremities, which are, on the one hand, an eminence called Mail Henri IV., and on the other, a rocky plateau. In artillery practice, the firing is done in the east-west direction, in other words, the pieces are put in battery on the Mail side, and fire their projectiles toward the plateau.

As for the objectives, the arrangement of these is such that they present to the *personnel* charged with the execution of the firing the aspect of a striking reality. They are representations, as faithful as possible, of defensive means or various obstacles—of troops in the act of marching or that have come to a halt; guns in battery or drawn by horses; men on foot or on horseback, and in dispersed order or in mass, etc.

A few details here will not be out of place.

In the way of obstacles, we remark in the proving grounds under consideration various epaulements of earth and a redan with escarpment wall, magazine shelter and guns in place. The redan is represented at B, in Fig. 2, which shows also a village with its church, A, a hermitage at H, and a certain number of pieces of walls. The village is made of boards. As for the walls figured, they consist of scantlings nailed to laths and painted white. The upper part, painted red, represents the coping, and a rectangle painted yellow, a door, etc. To an observer placed at a distance, the illusion is complete.

The study of the processes of representing troops is just as interesting. A board painted black and cut in such a way as to represent the head and shoulders of a man is held vertically by means of a picket driven into the earth. Here we have a sharpshooter crouching. An alignment of similar silhouettes offers the aspect of a line of infantry upon the knees. Nailed to the coping of a wall, it will give the idea of a series of defenders of the obstacle.

TELEPHONING FROM BOSTON TO CHICAGO.

Opening of the American Telephone and Telegraph Company's Telephone Line from Boston to Chicago, by the Governor of Massachusetts, February 7, 1893. The picture shows a group of telephone officials assembled at the Telephone Building, 125 Milk Street, Boston. His Excellency Governor Russell speaking to Chicago; next behind the governor stands Lieut.-Gov. Roger Wolcott; at the right Adj.-Gen. Samuel Dalton.

Three scantlings, 1·33 meters in height, are painted black, and assembled jointedly in such a way that the one in the center exceeds the two others by 30 centimeters. Here we have a man upright upon his legs. Let a certain number of these very simple apparatus be juxtaposed, and we shall have a line of infantry standing (Fig. 2, D). If, in distributing sharpshooters over the ground, it is desired to come still nearer the truth, it is necessary, instead of painting the scantlings black, to invest them with old wearing apparel.

Manikins of analogous structure and organization may serve to represent combatants grouped in a special manner, or staff officers, etc. As for the campaign guns, caissons and teams, they are, as well known, figured in conformity with the prescriptions of the committee of artillery of April 22, 1884. Silhouettes of sharpshooters are employed to represent the gunners.

In order to satisfy, in the rules, the exigences of the service of instruction, it is necessary to be able, at an opportune moment, to effect rapid changes of objectives. Now, such changes are obtained by a play of silhouettes arranged in such a way as to appear or disappear as many times as necessary, and that, too, at the will of the instructor. We give here, by way of example, a description of a line of disappearing infantry, represented in the foreground at C, Fig. 2.

The apparatus consists essentially of a large wooden axle supported by wooden bearings and established, perpendicularly to the line of fire, at the bottom of a trench in the form of a flattened V. The object of this arrangement is to protect both the axle and the silhouettes that it controls from the effect of bursting projectiles. The silhouettes consist of a wire frame simulating the human form and over which is stretched a black fabric. Levers are arranged to permit of revolving the axle, and consequently of raising or lowering the silhouettes at will. The maneuver of them is intrusted to men who actuate them by means of an iron wire cable, C (Fig. 2). The Fontainebleau proving grounds are equipped with eight lines of disappearing infantry, each 20 meters in length. Placed one behind another, they occupy an interval of 1,800 meters, whence it follows that their system, methodically utilized, permits of figuring the marching of a body of infantry gaining ground by successive bounds, and consequently constituting a movable objective. We also find in the proving grounds under consideration special apparatus designed to represent troops on a march and advancing and falling back in a continuous manner. A movable object of this kind (Fig. 2, F) consists of a system of two wheels or drums connected by an axle carrying uprights, to which are nailed horizontally arranged laths. Upon these latter are fixed silhouettes of infantry or cavalry soldiers. The traction, which may be effected in one direction or the other, is done by means of a cable drawn by a team of horses. The travel is about 700 meters. We must express our regret that, for want of space, we cannot here go into the very interesting details of this method of traction.

The installation, maintenance and maneuvering of these different objectives imply the organization of a force of operators. Now, as the maneuvering has to be executed in the course of the execution of the firing, this special force must necessarily be able to have at its disposal a certain number of shelters. Fig. 3 represents, to the left, the shelter formed for the men whose business it is to maneuver the line of disappearing infantry, C. Fig. 1 shows on a larger scale a few details of construction of this structure of security.

Essentially dismountable and of easy installation, a new model of low shelter comprises a full center arch of corrugated iron 1·5 mm. in thickness, composed of three parts riveted together and connected by angle irons; a plate closing the front provided with a sight hole 10 millimeters in height; a plate in the rear barring entrance to the shelter; a plate assuring the protection of the latter; and, finally, a *mask* protecting the front. The weight of the iron plates does not, as a whole, exceed 950 kilogrammes.

In order to effect the mounting of the shelter, it is well to proceed as follows: Upon the bottom of an excavation 1·2 meters in depth are established the arch and the front and rear closing plates and the mask. These four elements once in place, a ditch is excavated around the whole, and the earth therefrom serves to cover the arch to a depth of 1·5 meters. On the side of the batteries the shelter must be protected by a mass of earth 3·5 meters in thickness, in which are methodically buried two walls of dry stones. The organization of the Fontainebleau proving grounds includes a dozen shelters of this kind, each of sufficient size to accommodate eight persons.

The schools of instruction in firing would not be a true means of teaching if the troops called upon to take part in them were not, at every instant, informed

as to the results, good or bad, of their firing. It has, therefore, been necessary to organize a rational service of observation. To this effect the sites of the objectives have been numbered from 1 to 30, and small boards carrying numbers distributed as follows have been inserted in the earth: The proving grounds having been divided into three longitudinal zones, the sites numbered from 1 to 10 occupy methodically the left part, the sites numbered from 11 to 20 the middle portion, and the sites from 21 to 30 the right part. The establishment of this system of boards furnishes a sufficient number of datum points and permits of designating all the points of the ground with sufficient accuracy. The observers take their places in stations provided for the purpose, which are: (1) For campaign firing, the low shelters of the western route numbered from 1 to 4; those of Cormier, numbered 2 and 3; and (3) those of Salamandre and Redan; and for siege and place firing, the high shelters of Mont Morillon, Mont Aigu and of the Signal of Cormier. Each observer has assigned to him a transverse band (clearly determined) of the firing field. Thus, for example, the eight lines of disappearing objects pertain to the Cormier post No. 2. The results of the firing, duly observed, are immediately transmitted to the proper person by means of the telephone, for the grounds are provided with a telephone service. Two distinct lines, both starting from the Mail station, run, one of them along the north and the other along the south edge of the forest. These lines connect, between them, all the stations and shelters appropriated to the *personnel* of the different services—maneuver of the objectives, observation, telephone, and service of security.

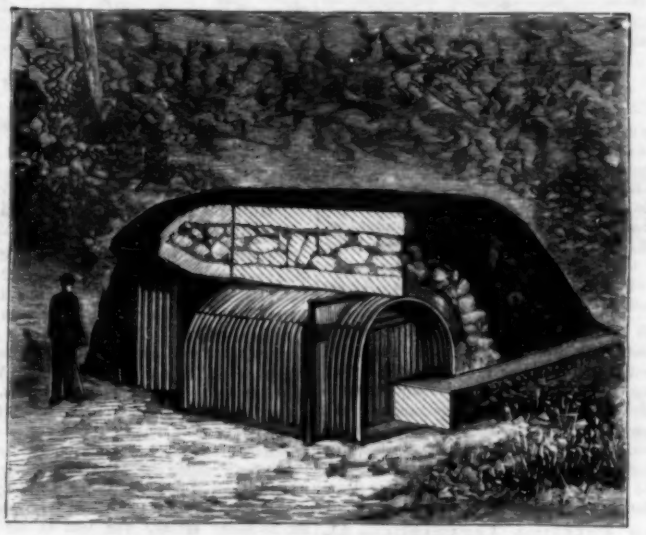


Fig. 1.—A LOW SHELTER OF THE FONTAINEBLEAU PROVING GROUNDS.

A word or two touching the mode of execution of the latter, which is of prime importance: In its essence, such execution is nothing less than easy, considering the exceptional conditions of the grounds in question. The Fontainebleau proving grounds are, in fact, crossed by four frequented roads and a large number of paths. It is, moreover, surrounded with woods.

In order to prevent, as far as possible, all chances of accidents, vedettes and orderlies, as well as sentinels installed in stations, are employed. Charged with the service of surveillance at a great distance, it is the duty of the vedettes to bring pedestrians, horsemen and vehicles upon the roads, which, crossing the grounds, are carefully guarded. These roads are barred by orderlies, whose instructions are to open them only upon the order of the commandant of the firing schools. Posts of surveillance are installed around the grounds, the principal of these being that of the Mail, which occupies a dominant position. In case the batteries are firing from the foot of the Mail, that is to say, when the zone to be interdicted is maximum, there is a concurrent and simultaneous operation of five posts of security (not including that of the Mail), each having its particular orders, viz.: Three posts of orderlies employed in guarding the Ronde, Orleans and Nemours roads; one post at the Puits du Cormier to watch the center of the field of fire, and one at the Salamandre to watch the back of the grounds. All these posts are connected by telephone and communicate with each other by the aid of signals, consisting of wooden frames covered with white cloth, which, when maneuvered, detach themselves very well from the dark background of forest trees. Moreover, acoustic signals are made when need be by a dozen trumpets. Upon the whole, the Fontainebleau proving grounds are, in a measure, a true stage upon which the low shelters (which are as it were the side scenes of it) permit the commandant of the schools of firing to operate changes of scenery, and even of view, at his will. This officer, in fact, can, at will, move almost all the objects, cause the appearance or disappearance of batteries, lines of infantry and sharpshooters, and represent troops in march, etc. Hence it follows that it is possible for him to give representations of actions of war possessing the stamp of reality.

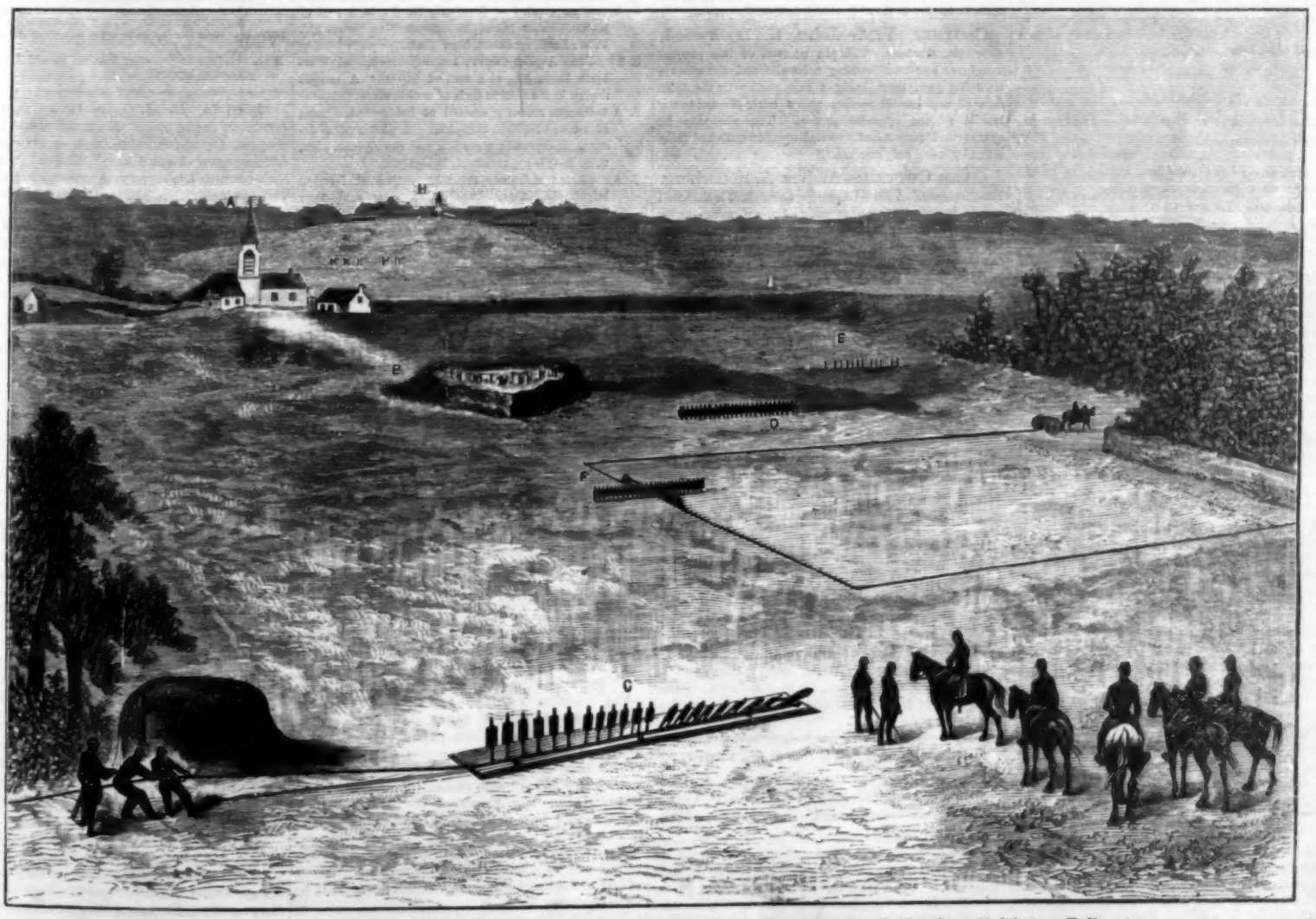
A director of maneuvers is, for example, able to cause a group of batteries to perform exercises of such a nature as to bring into relief the role that the artillery is called upon to play when it is a question of its sustaining an attack and of afterward seconding a defense. The programme of such operations would be, for instance, as follows: The setting in action of a battery of the group (vanguard battery) to fire upon the first infantry troops of the enemy and cause the latter to deploy; the enemy retiring and the infantry having, by supposition, gained ground, the marching forward of the group in order to put itself in battery against a line of the enemy's artillery already in position, and to begin the artillery duel; the enemy's artillery disappearing, the changing of objective in order to fire upon the infantry as well as upon a village supposed to be garrisoned with troops; the taking of position in front of the village by the enemy's artillery, in order to support the attack of the infantry and that of a line of cavalry charging one of the batteries.

Now if the reader will be kind enough to impress his mind with the descriptive details above given, he will be soon convinced that such a programme can be easily carried out upon the perfected proving grounds of Fontainebleau. It is an intelligently equipped stage upon which are produced scenes that one has a right to take for true images of the operations of war. The young student officers of the School of Application who take part in these interesting exercises can but acquire therein correct ideas as well as the precocious experience indispensable to him who wishes to practice the difficult profession of artillerist with distinction.—*La Nature.*

The Silk of Spiders.

In the *Revue des Sciences Naturelles Appliquées* for March, 1892, there is a paper by Rev. P. Camboue on the silk of spiders. After giving a history of the attempts to obtain and use the silk of spiders, he gives some interesting experiments of his own, made on a large orb-weaving spider of Madagascar, *Nephila madagascariensis* Vinson. He finds that the spider furnishes the most silk after she has laid her eggs. From one spider there was obtained in twenty-seven days nearly four thousand meters of silk—over three miles. The silk was of a golden yellow color. He gives the plan of an apparatus for winding the silk, which, however, as he says, is imperfect. Nothing, however, was done as to the raising and keeping of the spiders in large numbers, undoubtedly the most serious question.—*Nathan Banks.*

THE $3,000,000 which the hat manufacturers of the country have got to hand over to the inventor of the sweat band used on hats affords a striking illustration of the value of genius when it makes a hit.



A. Village. B. Redan. C. Line of disappearing infantry. D. Line of standing infantry. E. Line of sharpshooters. F. Line of movable infantry. H. Hermitage.

Fig. 2.—WESTERN PORTION OF THE FONTAINEBLEAU PROVING GROUNDS.

RECENTLY PATENTED INVENTIONS.

Engineering.

BOILER FURNACE.—Thomas J. Grosh, Savanna, Ill. The exterior cylindrical shell of this furnace has an inverted cone-shaped lower end forming a water compartment within which is the fire box, water flues in the inner surface of the sides and top of the shell extending within the combustion chamber, while a sleeve connects the top of the fire box with the removable cover of the shell, and a filling tube extends through the sleeve to deliver fuel to the fire. The water flues have their ends expanded and calked in the top and sides of the fire box, and the boiler is designed to be very effective, while avoiding all possibility of leakage at the tubes.

VALVE GEAR FOR STEAM ENGINES.—Thomas M. Pusey, Westchester, Pa. Within a casing mounted to turn and driven from the main driving shaft is a wing mounted to oscillate, and acted on by steam leading to the casing from the steam chest, while springs press on opposite sides of the oscillating wing and a shaft carrying the wing has a crank arm connected with the sliding valve for the inlet ports of the engine. The construction is simple and durable, and the valve is designed to utilize the steam to the fullest advantage.

VALVE FOR HYDRAULIC MACHINERY, ETC.—John W. Cabot, Boston, Mass. The valve body, according to this improvement, has connected cylinders with an inlet and outlet, and exhaust, in combination with two apertured valve seats, one between the inlet and outlet and the other between the outlet and the exhaust, apertured valves turning on these seats, and so arranged that when one opens the other closes. No gaskets, soft packing rings, etc., are employed in the valve, which is arranged to take up all wear and prevent leakage, so that, without any especial adjustment or attention, the machinery in connection with which it is used will stand motionless at any desired position without requiring additional hydraulic pressure.

STEAM BOILER AND WATER HEATER.—Thomas C. Andrews, New York City. This boiler comprises several sections, one on the other, secured together, with a central heat compartment and a hot water chamber around it in each section, all communicating, while there are communicating water return chambers exterior of the hot water chambers. The construction is designed to afford low pressure steam if desired, or hot water, for house warming purposes, in the most efficient manner.

Railway Appliances.

CAR COUPLING.—Arthur F. Nesbit, Milton, Pa. An arm having a projecting lug extends vertically into the link recess of the drawhead and rests against shoulders, while a lever fulcrumed on the drawhead carries the pivot for the upper end of the arm, the lug on the latter engaging the under side of the lever. The device is of simple and durable construction, the coupling taking place automatically as the cars come together, while the uncoupling may be effected either from the side or top of the car.

CAR COUPLING.—George S. Gaines, Corona, Ala. This is an improvement on a formerly patented invention of the same inventor, where swinging fenders were used to guide an arrow-head coupling link between the pin and a spring-bearing plate, to hold the link in coupled position. By the improved construction, the fender plate is rigidly held in the drawhead, and the rear end of the link is allowed free lateral play, while the apex or bent edge of the fender is arranged slightly in advance of the pin, and the link head is guided to pass the pin and engage the yielding spring plate.

Mechanical.

CARPENTERS' SQUARE.—Harry M. Stocking and Eugene L. Vroom, Castleton Corners, N. Y. This is a separable square, its arms being readily taken apart to pack the tool in small space, while it is of the exact shape of a one-piece square when its arms are locked in position. The locking mechanism is so located that it is not visible, and cannot interfere in any way with the use of the square, and this mechanism can be operated by a nail, the shank of an awl, etc.

CAM.—Giacomo Parcho, Sierra City, Cal. This improvement consists of two cam arms, each having a half hub, one of the arms having a slot extending on both sides of the half hub and adapted to be engaged by a tongue extending to both sides of the half hub of the other cam arm. The cam thus constructed may be conveniently and securely attached to a shaft without disturbing the other cams, or removing the shaft from its bearings.

GUIDE FOR STAMP MILLS.—Edmund Major, Turraville, South Dakota. This is an improvement on a formerly patented invention of the same inventor, providing for quickly and conveniently adjusting the several parts to take up wear, and without removing the blocks. The invention consists of a keeper adapted to be fastened to a girt or rail formed with downwardly and outwardly inclined sides, a flange being held adjustably on the keeper.

BUTTON TURNING MACHINE.—Martin Woods, Newark, N. J. A hollow drive shaft capable of endwise and rotary movement has at one end an interior beveled surface and is connected at the opposite end with a clutch, a spring bearing at one end on a fixed support and at the other end against the clutch, while a shaft turning in the hollow shaft has at one end a chuck with a conical surface to engage the beveled surface of the hollow shaft, a lever being connected with the clutch, by the manipulation of which the drive shaft is carried into frictional engagement with the chuck. The machine is very simple, works rapidly, and the cutting tool may be conveniently sharpened.

Agricultural.

BROADCAST HAND SEEDER.—Harm H. Franzen, Golden, Ill. The seed is carried in a bag suspended by a strap from the shoulder of the operator, and from one side of the bag at its bottom extends a telescopic sowing spout, in the outermost section of which are barriers to deflect and scatter the seed as it leaves the spout, there being also in the rear section of the spout a valve to control the quantity of seed delivered. The spout is turned or thrown from side to side to throw out the seed with force, and scatter it over a large area. The spout may be removed when going to or coming from the field, and the whole device takes up but little room.

ANIMAL HOLDER.—Oliver M. Kelso, Rock Rapids, Iowa. This is a cheap and convenient device for fastening together the feet of a hog, sheep, calf, or other animal, holding them comfortably and so the animal will not be injured. A bar with reduced rounded portions fits against the legs, and sliding yokes span its reduced portions, the yokes embracing the legs of the animal, there being sliding clamping pieces on the yokes, and fastening devices to secure them in position.

Miscellaneous.

KITE.—John W. Davis, New York City. This is a strong and collapsible kite, which may be folded in small space and carried on shipboard, and to be connected with lines so that it can be steered to carry a life line ashore or to drag a spar, buoy, or other article to the shore. On opposite sides of the center of the kite are secured bridles comprising several cords having their attached ends in alignment, flying lines being secured to the free ends of the bridles, and the kite has cross ribs, with a separate steering line secured to a cross cord connecting two of its projecting ribs.

STONE SEPARATOR.—James Cornelius and Edmund R. Collins, Brooklyn, N. Y. This is an improvement in machines for extracting stones from clay, that the clay may be cheaply and easily worked to produce a fine article in the way of porcelain, tile, and similar materials. The clay-feeding machine has a discharging nozzle, in which screens are held and adapted to move transversely, so that one screen follows and replaces another, the screens having inwardly extending stone-removing flanges.

TICKET PRINTING APPARATUS.—Albert R. Abbott, Boston, Mass. This is an apparatus designed to print all kinds of tickets, number them consecutively, and count the total of all the tickets issued as well as the total of each especial kind. The apparatus is more especially designed for use in theater ticket offices, on railroads, etc., enabling the operator to at once print and issue a ticket to any point or for any seat, and preserve a complete record of all the tickets thus issued.

BANK CHECK, ETC.—William T. Doremus, Flatbush, N. Y. This is an improvement on a formerly issued patent of the same inventor, providing an improved form of bank check, draft, or other like money order, to prevent changing, altering, or raising the instrument, which is made with spaces, numerals, and lines so arranged as to prevent fraud when filled out. A stub-like extension has spaces in each coupon division to contain a separate figure of the series in regular order, facilitating the writing of the signature under proper numerals, and serving as a readily discernible check on the amount.

TROUSERS HANGER.—Adolph Feiner, Lexington, Ky. Two body strips are arranged parallel and adapted to slide independently, and removably connected thereto are tabs constructed to received buttons and arranged in pairs, the tabs of each pair having a hinge connection. The device is simple and inexpensive, and can be quickly applied in such manner as to support the trousers to give to them the most desired shape.

CLOTHES PIN.—John B. Lockwood, Helmville, Montana. This pin consists of two pivoted members, one end forming a handle and the other a clamping jaw, there being a cam surface on the outer face of one handle section and a latch pivoted to the handle of the opposite section. The pin may be quickly and conveniently locked upon or unlocked from a line by using only one hand.

CAKE CUTTER.—Anders A. Soderberg, Boston, Mass. A frame carrying two rollers is designed to be run over the dough of which the cakes are to be made, the rollers being each armed with part cutters, whereby one part of each cake is cut by one roller and the other part by the other roller. The device is designed for both bakers' and family use.

Designs.

PATTERNS FOR TEXTILE FIGURES.—Jean Pierre Gelas, St. Etienne, France, has obtained three patents for designs, of which the leading feature of one is a button-like figure consisting of intersecting band-like figures, each composed of parallel strands, giving a ground work of hatched appearance. Another design has intersecting right-angled band-like figures, the middle portions being given a twisted columnar appearance, and the background having a wavy surface. In the third design, band-like and strand-like figures are produced in low relief, and are given a broken or plaid-like appearance, serving as a background for the strands and bands.

ORNAMENTATION OF GLASS.—William L. Pilkington, St. Helen's, England. In the surface of the glass oblique, parallel V-shaped grooves intersect and divide the surface into rectangular figures, in each of which is a depression, the four walls of the depression converging to a common center.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

THE AMERICAN GLOSSARY OF ARCHITECTURAL TERMS. By Geo. O. Gamsey. Chicago, Ill. Large 8vo, cloth. Price $2.00.

The definitions are concise, and the illustrations are printed on the left hand page and definitions on the right hand page. The work is undated, and we regret to say unpaged, but we learn from the preface that it is the third (1892) edition. The work makes no pretence to being a fine art volume, but is a thoroughly practical work for the use of students, builders, and architects. On the whole, it bears companion with Parker's Glossary of Architecture.

THE CELESTIAL PLANISPHERE. Price $3.00.

THE CELESTIAL PLAINSPHERE HAND BOOK. Compiled and edited by Jules A. Cowlas. Chicago: Poole Bros. 1893. Pp. xiv, 110. Price $2.

It is difficult to imagine how astronomy could be studied under more favorable auspices than with this planisphere and the very elegantly illustrated descriptive hand book accompanying it. The planisphere is of the usual type, except that, a skeleton screen being used, almost the entire sky area is uncovered. This in itself is a distinct advantage. Special scales for measuring polar distances and declinations accompanying the planisphere. The book and planisphere together give an admirable popular presentation of the heavens, and the two used as companions will, we are sure, meet with much appreciation. We feel that they can be warmly recommended to the public who are interested in distant worlds.

KASMAL IDIOMA. Gramatika uti Nove Prata Kiamso Orba. Da José Guardiola. Paris: Garnier Hermanos. 1890. Pp. 97.

The above is the title in the new Orba tongue of a little grammar for beginners in Sr. Guardiola's rival to Volapuk. The translation of the above title is "Universal Idiom. Grammar of a new language called Orba. By Jose Guardiola." The work marks a new attempt to create a universal language for use in commerce and for travelers. The author has not studied Volapuk. He therefore starts upon an unprejudiced basis. He aims at the production of a melodious language, trying to cut out all disagreeable sounds. Twenty-one of our letters suffice for his alphabet. Simplicity has been selected as the author's guiding star. One conjugation, undeclined nouns, the use of prepositions for the oblique cases are characteristic features. Less than three pages comprise the necessary syntax. The text of the book is in Spanish, and the treatment of the subject is remarkable for its scope and style.

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(4668) G. E. J. asks how construct a bell circuit so that he can place a bell at each end of the line, and ring up from either end on the same circuit, using an open circuit battery. A. You can arrange an open circuit bell to be rung at either end of the line by employing two wires, placing one bell, one battery and one push button in each wire, and using the ground for return in either case. 2. Please explain how to construct an electric telephone receiver for private use. A. You will find electric telephones described in SUPPLEMENT, Nos. 575 and 142.

(4669) A. H. writes: Please inform us what the standard rule is as to the number of cubic feet to a ton of ice. A. Solid ice is 38½ cubic feet to the gross ton, or 34½ cubic feet to the net ton. Ice in storehouse packed solid 42 cubic feet and 36 cubic feet respectively per ton.

(4670) P. F. D. asks what the process is for tinning or whitening small articles of brass. A. Immerse the brass articles, previously made perfectly clean, in a solution, boiling hot, of

Ammonia alum	17½ oz.
Boiling water	12½ "
Protochloride of tin	1 "

When properly whitened, wash in hot water.

(4671) J. C. A., Jr.—A good cat in your cellar or garret would probably soon rid your house of rats and mice, but if you prefer trying some other means, we would suggest baiting the rats and mice for a few days in one place, and afterward placing a trap of approved construction in that place, when you will probably be able to clear the house.

(4672) J. McR. asks: What is my best plan to erect building for storing stone lime to prevent slaking? A. Lime if to be stored for any length of time should be packed in tight barrels in a dry atmosphere or as soon as drawn from the kilns, and placed in a building that if made for the purpose should stand entirely clear of the ground, with a clean wind sweep under it and so arranged that the storage room can be opened free to the air when dry, and closed when the atmosphere gets moist or in rainy weather.

(4673) J. K.—You cannot operate a single incandescent lamp to advantage with storage batteries, and primary batteries are out of the question. Any storage battery that would operate a single incandescent lamp would furnish current enough for a series of lamps. Primary batteries require continual attention, and the light produced by them is expensive.

(4674) S. P. asks: 1. What is the usual way to fix railings, grills, etc., in concrete, in brick, or stone? What materials are used, how mixed and applied? A. Lead is generally used for fastening railings to stone. Holes drilled from 3 to 4 inches deep. Spuds or posts roughened at bottom, lead poured and caulked when cold. Pure Portland cement makes a good fastening for bricks, stone, or concrete, only requiring a little deeper setting, say 5 or 6 inches for stone and 6 to 8 inches for brick and concrete. The Portland cement should be mixed thick and driven in with a tamp. 2. Is there anything that can be applied to wood to make it impervious to water under pressure say of 150 pounds per square inch, as water pipes for instance? A. Wooden water pipes can be made impervious to water by immersion in hot asphalt for a few minutes and the asphalt drained out. Hot paraffine may also be used, but does not penetrate the wood as well as asphalt. 3. Suppose I wish to convert decimals of small denomination as 0·0001265 into the metric system, as equivalents, what should I call it? I find nothing lower than a millimeter. A. The reduction of a decimal value of any unit into a metric unit is made by multiplying the decimal by the ratio of the metric value to the primary unit value; so if your decimal is of one inch, your multiplier will be $\frac{1}{0·03937079} = 25·4$ — $\times 0·0001265 = 0·0032131$ of a millimeter. 4. What is lapping and how is it done? It is a finish I am told after grinding fine work in machine, etc. Are there any books on grinding and lapping published? A. Lapping is truing a surface on a flat wheel, which may be of metal charged with fine emery, or on the flat side of an emery wheel. See "Hand Book for the Artisan, Mechanic and Engineer," by O. Byrne, $5 mailed. It has a full description of polishing and lapidary work.

(4675) C. K. F. writes: 1. In a book by T. O'Conor Sloane he tells how to make a Lalande-Chaperon battery. He takes an empty tomato can, places a quantity of oxide of copper on a layer of iron borings, clippings, etc., on the bottom of the can; a porous cup is then placed in the inside of the jar filled with a 10 per cent solution of caustic soda, a zinc placed inside of this. He says the battery will give electromotive force 0·75 of a volt. How long do you think such a battery would last? Do you think it would pay to make some? Would it give the E. M. F. named above? Would it do as well to omit the porous cup and fill the can with the solution and suspend the zinc plate from the cover? Does a battery of this type emit any fumes or smell while at work? Do you think it would work? A. The porous cup or some equivalent is necessary in the battery as described, only to keep the zinc from touching the iron. An iron wire gauze cup might be used if the zinc were kept from contact therewith by blocks of wood. It gives a low E. M. F. 0·50 to 0·75 volt, has rather low resistance, but is not what is known as a strong battery by any means. It will last quite long and is excellent for open circuit work. The battery emits no fumes. 2. We made a motor of the Siemens type armature and wound for a series motor. It would not run when connected as a series machine on one large cell of the Ideal storage type; when we connected it as a shunt, it ran very fast. We have 6 coils No. 20 A. W. G. on armature, and No. 18 on field magnet; the armature is made up of iron washers with one-half pound of wire. Can you give explanation? A. Your motor, we presume, was of too high resistance for your battery. It ran on lower E. M. F. when connected in shunt.

(4676) J. J. K. writes: A says that the sharp cracking sound heard in steam pipes when steam is turned on in the morning is caused by the water remaining in the pipes, which is the condensed steam of the night previous. B contends these sounds are produced by the rapid expansion of the pipes in consequence of the steam rushing through them, and that the water produces only a low gurgling sound, which may be heard at any time steam is turned on. A. The cracking or hammering in steam pipes is made by the surging of the water of condensation from the steam. It may be water that has remained over night in the pipes if they have not been thoroughly drained, or the water condensed in cold pipes, which condenses the steam very fast when first turned on. The hammering may also occur at any time by neglect in properly providing for the drainage of all the pipes in the supply and return as well as the coils or radiators. The mere passage of the steam only causes a whistling noise, and the expansion and contraction of the pipes causes no noise whatever, unless a very great length of pipe drags on a solid fastening or support.

(4677) J. R. P. asks how to mend glass jars. A. The *Pharmacist* recommends the following as a proved recipe: "Take 1 ounce of Russian isinglass, cut it in small pieces, and bruise well, in order to separate the fibers, then add 6 ounces of warm water, and leave it in a warm place that the isinglass may dissolve, which will require from 24 to 48 hours. Evaporate this to about 3 ounces. Next dissolve ¼ ounce mastic in 4 ounces of alcohol, and when this is ready, transfer the isinglass from the evaporating dish to a tin can (an empty ether can will be found convenient), heat both solutions, and add the mastic solution to the isinglass in small quantities at a time, shaking the can violently after each addition. While still hot strain the liquid through muslin cloth and put up in ¼ ounce bottles. This cement is very valuable, and articles, such as mortars, graduates, etc., mended by it have been in use for years, and, in fact, seem to be stronger than they were originally." From the "Scientific American Cyclopedia of Receipts, Notes and Queries."

(4678) E. P. W. asks: What horse power engine would it take to drive a pump forcing water into a cylinder under a pressure of one thousand pounds to the square inch, the cylinder having an opening or discharge pipe of ¼ inch in diameter, the opening of ¼ inch to be open all the time and the pressure to be maintained at 1,000 pounds? A. You will require 12 horse power for maintaining the pressure as stated.

(4679) J. J. O'B. asks: Is hot air pumped into a boiler with an air compressor of any economical aid in doing the work with steam? Is it not dangerous to continually pump hot air into a boiler? Is it feasible to do the work with steam and hot air mixed in proportion of two to one—two of steam and one of hot air? If so, is there any economy in it? The working pressure is to be 100 pounds a square inch. A. There is no economy in pumping air into a boiler to use with steam. It costs more to compress air than the work it returns. There is no danger, and it is feasible, to use aerated steam in any desired proportion. The only economy ever claimed was the saving of the latent heat of the steam that the air displaced, but it costs more than the heat expended in compressing the air by a steam-driven compressor.

(4680) S. E. B. asks: Is there any foundation for the oft-advanced theory that burning zinc (in small pieces occasionally) in soft coal heaters will remove soot from stove pipes and chimneys? If not, is there any way to keep them free except by taking them down? A. There is a possibility that the zinc in oxidizing and passing through vertical pipes and chimneys deposits a coat of white oxide upon the surface, which may detach the soot that is afterward deposited and cause it to fall, when it may be readily cleaned out. We have no evidence that the soot is burned or destroyed by the zinc. We know of none but the old way of cleaning that is reliable.

(4681) J. C. W. writes: Please explain the following: During the present cold spell, many of the water pipes in our dwelling houses have been frozen, and singularly enough the hot water pipes were oftener closed than the cold ones, where hot and cold water were in use. Upon inquiry I find that this was not in isolated cases, but very generally, and in many instances the hot and cold pipes lie together. A. The heating of the water expels the air, which is often seen to spatter from the hot water faucets. Water without air, or from which air has been expelled by heat or otherwise, freezes slightly easier than aerated water.

(4682) G. W. R. asks how wide Behring Strait is at its narrowest point, and also the depth of the Strait at this point. A. Behring Strait is 60 miles wide. A small island is in the Strait 40 miles from the Alaska shore. Water of the Strait 25 fathoms deep.

(4683) F. K. H. writes: I would like you to please give me an answer why a bell worked on one wire, a galvanized wire, the wire three blocks distance, and I use the ground for return, have got six cells of battery. At the end of the line where the bell is, the current is so strong it can hardly be held in the mouth, and when the wires are touched to the bell it does not ring. I know that it is not the fault of the bell, because when it is connected direct from the battery it rings. A. Probably the difficulty with your electric bell is that its resistance is too great, or that you have not sufficient battery power to overcome the resistance of both the line and bell.

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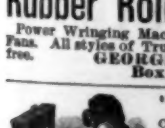

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